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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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W88-00001 -- W88-00962

The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1988 .

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

STRUCTURE OF WATER AND AQUEOUS SYSTEMS,
Marburg Univ. (Germany, F.R.). Fachbereich Physikalische Chemie.
W. A. P. Luck.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 21-72, 39 fig, 109 ref.

Descriptors: *Water, *Water properties, *Solubility, *Desalination, Physical properties, Electrolytes, Model studies, Membranes.

The salient features of an idealized model of liquid water are outlined, and the model is applied to aqueous solutions, especially to the structure of water in membranes. The structure of water is described using an approximate two-state model. Electrolyte solution are described on the basis of the model. The water solubility of molecules is considered, with discussion topics including solubility mechanisms in water, michelle formation, electrolyte effects on interfaces, ion solubility in organic solvents, organic hydrates, and coacervates. As examples of aqueous systems, the effects of ions on the water content of 6-nylon (polyamide) fibers is discussed, as is the effect of relative humidity on the water band maxima of samples of collagen, cartilage and gelatine. Finally, water in desalination membranes and the desalination mechanism are considered. The structure of water in efficient desalination membranes differs from that of liquid water. All efficient desalination membranes showed weaker hydrogen-bond systems than liquid water. This confirms the assumed hypothesis that desalination membranes should contain only primary hydration water and not liquid-like water. (See also W88-00700) (Halterman-PTT)
W88-00702

1B. Aqueous Solutions and Suspensions

EXPERIMENTAL METHODS FOR THE DETERMINATION OF THE PROPERTIES OF SALINE WATER,
National Engineering Lab., East Kilbride (Scotland).
For primary bibliographic entry see Field 7B.
W88-00087

INVESTIGATION OF GROWTH INSTABILITIES OF THE ICE-WATER INTERFACE BY LIGHT SCATTERING SPECTROSCOPY,
For primary bibliographic entry see Field 2C.
W88-00535

STRUCTURE OF WATER AND AQUEOUS SYSTEMS,
Marburg Univ. (Germany, F.R.). Fachbereich Physikalische Chemie.
For primary bibliographic entry see Field 1A.
W88-00702

2. WATER CYCLE

2A. General

MULTIDIMENSIONAL MODEL OF NONSTATIONARY SPACE-TIME RAINFALL AT THE CATCHMENT SCALE,
Princeton Univ., NJ. Water Resources Program.
M. Sivapalan, and E. F. Wood.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1289-1299, July 1987. 13 fig, 1 tab, 13 ref, append. NASA Grant NAG-5-491 and U.S. Department of the Interior Grant 14-08-0001-G1138.

Descriptors: *Stochastic models, *Statistics, *Rainfall-runoff relationships, *Rainfall models, *Nonstationary space-time rainfall, *Model studies, *Catchment areas, Storms, Rainfall, Mathematical equations, Statistics, Statistical methods, Rainfall intensity, Rainfall simulators.

A multidimensional model of nonstationary space-time rainfall over a catchment due to a single storm event is based on a conceptual representation of the essential features of an extratropical cyclonic storm. The storm is assumed to consist of a hierarchy of scales of which the smallest are the rain cells which are embedded within the small mesoscale areas, which are then embedded within the large mesoscale area or rainband. The mean and nonstationary space-time covariance are derived for the conceptual rainfall model. In addition, the statistics and stochastic dependence structures of rainfall intensity aggregated or averaged over finite times and finite areas are also derived. The finite areas represent catchments and subcatchments over which the rainband passes. Finite times could represent the scales at which rainfall measurements are made. A rainfall generator was developed based on a quasi-stationary approximation to the nonstationary space-time autocorrelation. The generated rainfall traces not only reproduce the specified space-time correlations but also exhibit storm movement, the cellular structure of storms, and the birth and decay of cells and cell clusters. (Author's abstract)
W88-00040

NEAREST-NEIGHBOR METHODS FOR NONPARAMETRIC RAINFALL-RUNOFF FORECASTING,
American Telephone and Telegraph Co., Denver, CO.
M. Karlsson, and S. Yakowitz.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1300-1308, July 1987. 5 fig, 6 tab, 16 ref. NSF Grant CEE-81-10788.

Descriptors: *Stochastic hydrology, *Rainfall-runoff relationships, *Forecasting, *Nearest-neighbor method, *Data interpretation, *Regression analysis, Comparison studies, Mathematical equations, Mathematical studies, Coshocton Basin, Ohio, Unit hydrographs.

A nonparametric regression method for time series known as the nearest-neighbor (NN) method, was motivated by the classical rainfall-runoff forecasting problem. It was previously shown that in the time series setting it has attractive large-sample properties including asymptotic convergence to the optimal forecaster under many circumstances in which the forecaster is not a linear function of the data. The technique was applied to a sequence of about 3000 seasonalized rainfall-runoff pairs from the Coshocton Watershed in Ohio. The NN forecasting performance on a split sample was compared with those of autoregressive maximum (ARMAX) and instantaneous unit hydrograph (IUH) forecasters. ARMAX and NN methods gave better forecasts than IUH and are both more algorithmic in the forecasting mode. No data preprocessing for base flow is required and the identification methods, in contrast to the IUH methods, are obvious and standard. (Wood-PTT)
W88-00041

USE OF WEIGHTED INTEGRAL VARIABLES TO DETERMINE THE RELATION BETWEEN RAINFALL INTENSITY AND STORM FLOW AND PEAK FLOW GENERATION,
Melbourne Univ., Parkville (Australia). School of Agriculture and Forestry.
L. J. Bren, P. W. Farrell, and C. J. Leitch.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1320-1326, July 1987. 7 fig, 2 tab, 16 ref, 2 append.

Descriptors: *Rainfall-runoff relationships, *Flood forecasting, *Rainfall intensity, *Storm runoff, *Flood peak, *Integral variables, *Regression analysis, *Data interpretation, Australia, Catchment areas, Rainstorms, Mathematical studies, Mathematical equations, Prediction, Comparison studies.

Previous work using a storm flow separation technique has established that peak rainfall intensities have little predictive value in the determination of storm flow depth or storm peak flow from small upland streams emanating from forested catchments. From this observation, it may be inferred that storm rainfall intensities have little influence on either the volume of storm flow or peak flow. To obtain additional information a variant of the technique was applied to excellent records from two separate, steep, upland catchments in southern Australia. The catchments were regarded as having quite distinct rainfall response characteristics by hydrologists involved in data collection. Antecedent flow, storm rainfall, and measures of maximum rainfall intensity were supplemented by weighted integrals of rainfall intensity with time to test whether they gave additional insight into the influence of rainfall intensity. As expected, regression analysis showed that knowledge of maximum intensities gave little increase in predictive ability over storm rainfall. However, the time integral of rainfall intensity to the power of 1.5 was better correlated with peak flow than any other measure on both catchments. The results suggest that rainfall intensities are more important in the generation of peak flows than indicated by regression analysis using only peak rainfall intensities. Comparison of independent measurements of the variables using separated rain gauges showed that independent measures of the weighted variables were better correlated than measures of storm maximum intensities, indicating that they are also a more precise measure. (Author's abstract)
W88-00043

HETEROTROPHIC GLUCOSE UPTAKE POTENTIAL OF THREE MARINE DINOFLAGELLATES,
Tvarminne Zoological Station (Finland).
T. Tamminen, S. Kaitala, and L. Iliash.
IN: Publications of the Water Research Institute, National Board of Waters, Helsinki, 1984. p 21-25, 1 fig, 2 tab, 16 ref.

Descriptors: *Dinoflagellates, *Glucose, *Marine algae, *Plankton, *Limnology, *Hydrobiology, *Gymnodinium, Heterotrophic bacteria, Aquatic environments, Algae, Kinetics, Dissolved solids, Organic compounds.

The heterotrophic potential of the marine dinoflagellates Prorocentrum micans Ehr., Gymnodinium splendens Lebour. and Gyrodinium fissum (Lev.) was studied in unialgal cultures as net assimilation of Cl4-glucose during light and dark incubations. The heterotrophic potential of algal cells was highest in the early stages of culture growth. Light and dark incubations did not differ significantly in heterotrophy. G. splendens had the highest heterotrophic potential according to both maximum velocity per cell and the half-saturation constant (K) of glucose. Half-saturation constants (140-1000 micrograms glucose/L) exceeded those usually measured in natural planktonic communities by one to three orders of magnitude. It therefore seems unlikely that measurements of the heterotrophic activity or potential of natural microplankton would be affected by these mixotrophic algae to any significant extent. (See also W88-00208) (Author's abstract)
W88-00233

DETERMINATION OF THE MICHAELIS-MENTEN KINETIC PARAMETERS WITH SINGLE CONCENTRATION ASSAYS,
Tvarminne Zoological Station (Finland).
J. Kuparinen, K. Lahti, T. Talsi, T. Tamminen, and A. Virtanen.
IN: Publications of the Water Research Institute, National Board of Waters, Helsinki, 1984. p 26-34, 5 fig, 2 tab, 22 ref.

Descriptors: *Kinetics, *Assays, *Correlation analysis, *Mathematical studies, *Turnover time, Trophic level, Oligotrophy, Eutrophication, Glucose, Substrates, Lakes, Brackish water.

Results from a number of studies in fresh- and brackish water environments were used to study the relationship between heterotrophic activity parameters derived from kinetic and single concen-

tration assays. Results showed good agreement between kinetic and single concentration parameters. The concentration sum representing the half-saturation constant + naturally occuring substrate concentration (K + S) from the kinetic assay may be used to determine approximate concentration levels for single concentration assays provided that the (K + S) value has been determined over a wide range of substrate concentrations. One-tenth of (K + S) is used to calculate the turnover rate (1/T) where T is the turnover time of the given substrate. Tenfold (K + S) is used for calculating the heterotrophic potential (V) where V is the maximum uptake velocity of the given substrate. In oligotrophic conditions, 0.1 micrograms of glucose/liter appeared to be low enough for the 1/T determinations and 30 micrograms of glucose/liter high enough for the V determinations. In eutrophic waters, glucose concentrations >100 micrograms/liter may have to be used for the V determinations. In oligotrophic waters and in calculating substrate flux rates, the single concentration assay should be used for turnover rate determinations. However, in highly eutrophic and polluted waters, the kinetic assay seems to be the best approach for heterotrophic potential determinations. (See also W88-00208) (Geiger-PTT)
W88-00234

PRACTICAL APPROACH TO THE MEASUREMENT OF MICROBIAL HETEROTROPHIC ACTIVITY BY THE SINGLE CONCENTRATION METHOD,
Tvarminne Zoological Station (Finland).
J. Kuparinen, J. Lahti, A. Makela, S. Rekolainen, and T. Talsi.
IN: Publications of the Water Research Institute, National Board of Waters, Helsinki, 1984. p 35-41, 4 fig, 16 ref.

Descriptors: *Limnology, *Heterotrophic bacteria, *Radioactivity techniques, *Microbiological studies, *Biological samples, *Sample preparation, Hydrobiology, Biological properties, Radioactivity, Substrates, Glucose, Sampling, Respiration.

The technical procedure of the single concentration method for the measurement of parameters describing microbial heterotrophic activity in the aquatic environment is described. Four parameters can be derived with the single concentration method. Three of these (heterotrophic activity, heterotrophic potential, and respiration percentage) are based on actual measurements, and the fourth (concentration sum) can be calculated from two of the parameters. Samples should be taken aseptically and all the glassware for sample treatment and incubation should be sterile. Incubations should be carried out in situ in order to minimize errors caused by storage and handling. The correct choice of incubation time is important. No more than 5% of the added radioactivity should be taken up during incubation. Samples for net assimilation measurements are filtered on membrane filters which are either dissolved in suitable scintillation cocktails or combusted with an oxidizer. Perhaps the most serious source of error is caused by the time lag between sampling and incubation. If the storage time exceeds the turnover time, the state of the sample may change markedly. (See also W88-00208) (Geiger-PTT)
W88-00235

CONTRIBUTION OF GROUNDWATER AND SUBSURFACE FLOW TO THE STORMFLOW HYDROGRAPH AS INDICATED BY THE RESULTS OF A RAINFALL RUNOFF PLOT,
G. J. Mulder.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p. 78-89, 5 fig, 1 tab, 14 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff, *Storm runoff, Hydrographs, Subsurface flow, Groundwater movement, South Africa, Infiltration, Drainage, Rainfall intensity, Stream discharge.

A runoff plot at the University of Zululand was used to study the extent that surface, subsurface, and groundwater flow along a hillslope contribute to the stormflow hydrograph. Monthly rainfall-runoff statistics were compiled for October 1980 to September 1981. The total rainfall during this period was 1322.6 mm. Runoff was divided among surface (1.355 mm) and groundwater (104.325 mm). Groundwater contribution was 98.5%. Runoff response to rainfall averaged 8%. (See also W88-00363) (Cassar-PTT)
W88-00396

ADVANCES IN THE IDENTIFICATION AND ANALYSIS OF ORGANIC POLLUTANTS IN WATER, VOLUME 2.
Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. 2 v.(11170 p.).

Descriptors: *Water analysis, *Organic compounds, *Pollutant identification, *Wastewater analysis, *Fate of pollutants, Separation techniques, Gas chromatography, Mass spectrometry, Industrial wastes, Drinking water, Water quality, Trace levels, Monitoring, Automation, Surface water, Chromatography.

Most, but not all, of the chapters of this book were derived from a symposium sponsored by the American Chemical Society Division of Environmental Chemistry on the identification and analysis of organic pollutants in water. It constitutes a sequel to Volume 1 which was based on a symposium of the same title held during the First Chemical Congress of the North American Continent in Mexico City. In the ensuing years, advances in the identification and analysis of organic pollutants in water have continued at an accelerated pace. Thus, it was only natural that the second symposium on this subject be held during the Second Chemical Congress of the North American Continent in Las Vegas, Nevada. The advances described in these volumes represent the current state-of-the art methodology for analysis of organic compounds, often at trace levels, in all types of water samples ranging from very pure drinking water to extremely impure industrial wastewater. Topics covered in this volume are global water quality monitoring, computer applications in the collection and interpretation of water analysis data, Grob closed-loop stripping, specialized purging techniques, drinking water analysis, surface water analysis, and industrial wastewater analysis. (See W88-00407 thru W88-00433) (Geiger-PTT)
W88-00406

AGTEHM: DOCUMENTATION OF MODIFICATIONS TO THE TERRESTRIAL ECOSYSTEM HYDROLOGY MODEL (TEHM) FOR AGRICULTURAL APPLICATIONS,
Oak Ridge National Lab., TN. Computer Sciences Div.
D. M. Hetrick, J. T. Holdeman, and R. J. Luxmore.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-015857. Price codes: A07 in paper copy, A01 in microfiche. Publication No. 1770, May 1982. ORNL/TM-7856. 115 p, 6 fig, 1 tab, 12 ref, 3 append. Contract No. W-7405-eng-26.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Runoff, *Soil-water-plant relationships, AGTEHM model, TEHM model, Ecosystems, Vegetation, Interception, Throughfall, Infiltration, Root zone, Evaporation, Transpiration, Drainage, Soil water potential, Plant water potential, Water potentials, Subsurface flow, Surface runoff, Open channel flow, Irrigation, Sprinkler irrigation, Flood Irrigation, Hydrology, Hydrologic models, Land use, Terrestrial Ecosystem Hydrology Model.

AGTEHM, an agricultural application version of TEHM, the Terrestrial Ecosystem Hydrology Model, is the outgrowth of more than a decade of effort to realize a model of the complex interrelations of air, water, land, and vegetation. TEHM combines mechanistic algorithms for climatic and hydrologic processes with vegetation properties to explicity simulate interception, throughfall, infiltration, root zone evaporation, transpiration, drainage, plant and soil water potential, unsaturated and saturated subsurface flow, surface runoff, and open channel flow. AGTEHM was developed from TEHM, and several innovations have been added for agricultural applications. These include changes in the input data options, algorithms for sprinkler and flood irrigation, and alternative surface resistance-water potential relationship, a variable-contributing-area function, and the coupling of a model for soil macropore effects on water flow. Several internal changes to the original code have been made to increase calculation efficiency. This report is intended as a companion to the TEHM report and describes those features not previously documented. (Author's abstract)
W88-00482

CONTINUOUS SYNTHESIS OF RUNOFF FROM THE KAWISHIWI RIVER BASIN IN NORTHEASTERN MINNESOTA BY THE RIVAL HYDROLOGIC MODEL,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2E.
W88-00540

PROCEDURE FOR ESTIMATING FLOW-DURATION CURVES FOR UNGAGED MOUNTAINOUS AND HIGH PLAINS STREAMS IN MONTANA,
Montana State Univ., Bozeman. Dept. of Civil Engineering.
A. B. Cunningham, and D. A. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197653/AS. Price codes: A04 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Bozeman, Report No. 135, June 1983. 47 p, 27 fig, append. Project No. OWRT A-137-MONT (1). Contract No. 14-34-0001-2128.

Descriptors: *Flow duration, *Drainage area, *Montana, Synthesis, Hydrologic analysis, Precipitation, Gaging stations, Gaged streams, Ungaged streams, Hydrologic similarity, Estimated flow duration curve.

A procedure for estimating shape and magnitude of flow-duration curves for ungaged stream locations in Montana has been developed. This procedure utilizes a dimensionless flow-duration curve which is determined based on streamflow records from a particular hydrologic region. The dimensionless curve is 'scaled' to an ungaged site using drainage area and mean annual precipitation as determined from suitable maps. Methodology requires that individual judgement be used in selecting flow-duration curve shape, especially if spring flow and/or regulation exist above the chosen site. Accuracy of this procedure will vary depending on the degree of hydrologic similarity between the ungaged site and the gaged streams used to develop dimensionless curves. (Peavy-Mt St. U.)
W88-00550

SURFACE WATER RESOURCES OF SOUTH AFRICA: VOLUME V, DRAINAGE REGIONS MNPQRST, THE EASTERN CAPE, PART 2, (APPENDICES),
University of the Witwatersrand, Johannesburg (South Africa).
B. J. Middleton, S. A. Lorentz, W. V. Pitman, and D. C. Midgley.
Report No. 12/81, Hydrological Research Unit, January 1982. 425 p.

Descriptors: *Hydrological models, *Model studies, *Rainfall-runoff relationships, *Surface water, *Reservoirs, *Rivers, *Meteorological data collections, South Africa, Precipitation, Runoff, Streamflow, Sediments, Water management, Evaporation, Frequency analysis, Water storage, Maps, Land use, Synthetic hydrology, Computer models, Regional analysis.

This volume contains the appendixes necessary to use the hydrologic models described and illustrated in the text (Part 1, a separate volume). This data specifically concerns the surface water resources of eastern Cape region of South Africa. Appendixes are as follows: hydrometeorological data (rainfall, streamflow, and evaporation), land use

(irrigated areas, afforested areas, reservoirs), breakdown of tertiary catchments, model parameters, synthetic hydrology, subcatchment characteristics, and determination of storage requirements. (See also W88-00659) (Cassar-PTT)
W88-00660

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FIELD STUDIES, DATA PROCESSING, TECHNIQUES AND MODELS FOR APPLIED HYDROLOGICAL RESEARCH VOLUME 2 - SUMMARY OF FINDINGS,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
University of Natal. Agricultural Catchments Research Unit Report No 7, Vol 2, p 1-29, August, 1979.

Descriptors: *Catchment areas, *Hydrologic data, *Geomorphology, Soil surveys, Climatology, Land use, Data processing, Analog digital converters, Computer programs, Mathematical models, Flood forecasting, Model studies, Storm runoff, Peak discharge, Trend surface analysis, Mapping, Soil water, Spatial distribution, Soil erosion, Erosion rate, Thunderstorm, Review, South Africa Cedara.

An overview of the comprehensive report (volume 1) is given. Only the main results, conclusions, and recommendations are presented here. This summary has been conveniently divided into five sections. These sections are: Section A: The Cedara Catchments - Physical Background; Section B: Data Processing and Manipulation; Section C: Hydrological Models and Techniques; Section D: Hydrological Studies of Soil Loss; Section E: Flood Producing Rainfall in Natal. Techniques, results and recommendations have been presented which will be applied and further tested by hydrologists in South Africa at both research and operational levels. This report testifies to a number of needs in hydrological research, namely: a need for more input data, a need for further improvements to hydrological models, a need for further improvements in techniques, and a need for more sophisticated data manipulation. (USGS)
W88-00663

STUDY OF RUNOFF AND EROSION PROCESSES USING LARGE AND SMALL RAINFALL SIMULATORS,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
T. J. Ward.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-215075/AS. Price codes: A05 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 215, November 1986. 71 p, 15 fig, 12 tab, 21 ref. State Project No. 1423672.

Descriptors: *Simulation analysis, *Simulated rainfall, *Computer models, *Data collection, Hydrologic models, Hydrologic processes, Infiltration, Parametric hydrology, Runoff plot, Sediment yield, Soil erosion, Watersheds, Simulators.

Process oriented mathematical models can be an important part in estimating runoff and sediment yield from small, ungaged watersheds. Rainfall simulation is an important experimental technique for gathering information which is directly related to the hydrologic processes occurring on the watershed. This report contains the results of a pilot study on the utility of using rainfall simulation in southwestern watersheds. Two different simulators were compared on three sites in New Mexico. A small area simulator, 10 sq ft, and a large area simulator, approximately 2000 sq ft, were operated for a total of 60 plot experiments. The large simulator was modified and operated with variable intensity rainfall and with overland flow without rainfall for some experiments. Analysis of the data indicates that the simulators provide similar results for hydrologic processes, and that sediment yields averaged about 2.7 times higher for a small simulator. Addition of the variable intensity and overland flow capabilities to the large simulator have provided a means for is
important processes. (Ward-NM St. U.)
W88-00714

STREAM-AQUIFER INTERACTION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. A. Liggett.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207130/AS. Price codes: A04 in paper copy, A01 in microfiche. New York Water Resources Research Institute, Ithaca. Technical Completion Report, August 1984. 35 p, 5 fig, 23 ref. Contract No. 14-08-0001-G859. Project No. USGS G859-02.

Descriptors: *New York, *Computer models, *Stream-aquifer interaction, *Groundwater, *Surface-groundwater relationships, *Computer programs, *Routing, Streamflow.

The specific objective of the research was to develop a better understanding and methodology of computing the interaction of groundwater and surface waters, and to quantify, through computer analysis, the interaction between the time varying flow in the stream, the rise and fall of the groundwater level, and the flow between the two. A simple model (the Muskingum routing method) was chosen for the streamflow routing to reduce the complexity of the program since the primary focus was on groundwater. A standard boundary element method was used for the groundwater calculation. The computational mesh is automatically generated by the program using the channel data and the depth and distance to the free surface of the aquifer. The hydraulic conductivity and effective porosity of the aquifer complete the necessary specifications. This project demonstrated that computer programs do not need to be large and complex. The program developed uses less than ten lines of data, excluding hydrograph data, for a simple case and runs rapidly; it can be run on a microcomputer. The program represents a platform on which can be constructed a hierarchy of increasingly complex models. (USGS)
W88-00743

REVERIFICATION OF THE CHESAPEAKE BAY MODEL; CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2L.
W88-00862

HYDRAULIC MODELLING,
Memorial Univ. of Newfoundland, St. John's.
J. J. Sharp.
Butterworths, London. 1981. 242 p.

Descriptors: *Hydraulic models, *Models, *Model studies, *Hydrologic models, *Structural models, Theoretical analysis, Simulation analysis, Hydroelectric power, Mathematical models, Snow, Ice, Rivers, Hydraulic structures.

This book provides a comprehensive guide to the theory and practice of hydraulic models, and their design, construction and operation. Many hydraulic phenomena are too complex to be described by mathematical methods. Even the effects of conventional engineering projects such as spillways and river barages cannot be reliably predicted by theory. Scale models play a decisive part in the evaluation of many hydraulic schemes. Models are of limited value if they fail to reproduce physical phenomena accurately. Models must be correctly designed and instrumented, and the test observations interpreted with a full knowledge of the scale effects and the limitations inherent in modelled systems. Partial analysis is the theoretical basis of model testing and occupies much of Part 1 of the book (General Theory), which also includes the necessary study of similarity theory and scale errors. Drawing on experience in the United Kingdom, Canada, and Africa, the modelling of river, tidal, thermal and effluent schemes is described in Part 2. Sections on hydroelectric schemes, and snow and ice models are also included. Hydraulic modelling will appeal to practicing engineers and consultants involved in the design and construction of hydraulic projects. The book will also serve engineering students through final year degree level and into post-graduate studies. (Geiger-PTT)
W88-00882

FOREST ECOSYSTEMS: CONCEPTS AND MANAGEMENT,
Oregon State Univ., Corvallis. Dept. of Forest Science.
R. H. Waring, and W. H. Schlesinger.
Academic Press, Orlando, Florida, 1985. 340 p.

Descriptors: *Ecosystems, *Forests, *Forest watersheds, *Forest management, *Forest hydrology, Water management, Nutrients, Cycling nutrients, Cutting management, Succession, Ecology, Soil-water-plant relationships, Logging, Forestry, Forest soils, Baseline studies, Climatology.

This book attempts to explain some of the key linkages between the processes that operate in forest ecosystems to provide a baseline for studies on periodic disturbances to such ecosystems. Topics examined include: the carbon balance of tress, forest productivity and succession, tree-water relations, the hydrology of forest ecosystems, nutrient cycling through forests, nutrient uptake and internal plant distribution, decomposition and forest soil development, susceptibility and response of forests to natural agents of disturbance, linkage of terrestrial and aquatic ecosystems, and forests and global ecology. Common underlying processes control water movement in forest ecosystems: evaporation, transpiration, snow pack energy balance, infiltration, percolation, lateral flow, and capillary rise. The hydrologic processes aid in evaluating the leaching and cycling of nutrients, movement of organic and inorganic material into streams and rivers, and the potential effects of clearing large areas of forests in various regions. The input of sediment and organic materials critical for stream life is controlled by streamside vegetation. Road construction and logging methods should strive to minimize erosion in forest watersheds. Through an understanding of how river systems operate and their dependence on the adjacent forest, new approaches to river management are possible. (Geiger-PTT)
W88-00883

SPECIAL GROUNDWATER STUDY OF THE MIDDLE DELAWARE RIVER BASIN, STUDY AREA, VOLUME I, (CHAPTERS 1-7),
Wright (R.E.) Associates, Middletown, PA.
R. E. Wright.
(1983). 178 p, 48 fig, 17 tab, 2 append. Prepared for the Delaware River Basin Commission.

Descriptors: *Delaware River Basin, *Geologic units, *Geohydrology, *Groundwater hydrology, *Geologic fractures, Igneous rocks, *Metamorphic rocks, *Sedimentary rocks, River basins, Geologic mapping, Policy making, Aquifers, Groundwater storage, Geologic joints.

Groundwater resources of the Middle Delaware River Basin were evaluated in terms of the consolidated rock strata and associated groundwater quality and quantity parameters in a four-volume study. In this volume, the framework of the hydrogeologic regime is defined, including the water budget and the groundwater development potential. Because of the prolific yield of the Triassic aquifers and the economies associated with groundwater development, urban sprawl has extended heavy water supply demands northward and westward from Philadelphia. Portions of three physiographic provinces: the Piedmont, the New England, and the Valley and Ridge, occur within the boundaries of Study Area II. Igneous and metamorphic rocks tend to comprise the poorest aquifers in the area due to their relative resistance to deformation and weathering. Saprolite is the best water storing and water-transmitting part of this rock system. The storage capability of igneous and metamorphic units is also generally very low, with a storage coefficient of 0.002 in the upper 200 feet of the bedrock. The Triassic sedimentary units are comprised of a diverse series of sandstone, siltstone, and shale strata. The dominant strike direction of

lineaments in the study area is due north to N10 degrees W. Fracturing appears to exist to a greater degree in fracture trace zones. Relatively low rates of precipitation and streamflow, and low water-table levels, were seen in 1980 and 1981. Initial withdrawal limits equal to the 10-year frequency baseflow rate per aquifer type should be the hydrologic water budget guide. (See W87-00921 thru W87-00924) (Hawkins-Omniplan)
W88-00921

PHYSIOGRAPHY AND THE HYDROLOGICAL NETWORK,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 1-18, 1979. 11 fig, 4 tab.

Descriptors: *Catchment areas, *Geomorphology, *Hydrologic data, *Networks, Rain gages, Stream gages, Meteorological data collection, Weather data collection, Topography, Surface runoff, Weirs, Water storage, Water depth, Hydrographs, Hydrologic equation, Flood peak, South Africa, Natal, Cedara.

Chapter 1 of Section A: The Cedara Catchments - General Background, describes the location and the main physiographic characteristics of the Cedara Catchments. In 1976 five small agricultural catchments were instrumented, these catchments having been selected as representative in land use, soils and physiography of large parts of the Natal Midlands, one of the most intensively farmed regions in South Africa under plantations, crops and pastures. The catchments, ranging in size from 0.095 sq km to 5.250 sq km and covering a total area of 9.254 sq km are drained by the Rietspruit and its tributaries. They form a subcatchment of the Mgeni, one of the most important river systems in Natal. The hydrological network is explained in terms of instrumentation and storage: depth equations were derived for the stilling basins of the five streamflow gaging weirs. (USGS)
W88-00950

CLIMATE,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 19-40, 1979.

Descriptors: *Catchment areas, *Climatology, *Weather data collection, Spatial distribution, Temporal distribution, Hydrometeorology, Temperature measurement, Winds, Relative humidity, Evaporation rate, Rainfall rate, Drought, Thunderstorms, Flood flow, Fog, Soil water, South Africa.

Chapter 2 of Section A: The Cedara Catchments - General Background, aims at evaluating the overall climatological characteristics of the catchments. For the temporal analysis of climate, up to 62 years' data were available from the first order meteorological station at Cedara. For the spatial analysis a maximum of two years' data were available for computations. The variables discussed are sunshine, temperature, relative humidity, wind, pan evaporation, rainfall and fog. (USGS)
W88-00951

LAND USE,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 56-65, 1979. 4 fig, 2 tab.

Descriptors: *Hydrological data, *Land use, *Vegetation effects, Forests, Mapping, Aerodynamic characteristics, Soil water, Biomass, Roughness.

Chapter 4 of Section A: Cedara Catchments - General Background, describes the land use/vegetation surveys of the catchments which have been undertaken from a functional rather than a botanical viewpoint, with emphasis placed on factors used in water yield, flood and soil loss modeling. Applications of the survey are illustrated in chapter 10 and particularly Chapter 13 where point values of parameters extracted and derived from the land use data file form an integral part of soil loss models described. (USGS)
W88-00953

BREAK-POINT DIGITIZING OF CHARTS AND PREPARATION OF DATA FOR HYDROLOGICAL ANALYSES,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 66-79, 1979. 2 ref, append.

Descriptors: *Hydrologic data, *Data processing, *Hydrometeorology, Analog digital converters, Rain gages, Streamflow, Stream gages, Weirs, Surface runoff.

Chapter 5 of Section B: Data Processing and Manipulation, briefly describes chart editing, chart digitizing and error checking preparation of control cards for analysis in the light of experience gained (1975-1978), the hardware available at the University of Natal, Pietermaritzburg and the software developed. A user oriented computer printout is given for the digitizing program. (SAWIC)
W88-00954

DATA BANK OF DIGITIZED RECORDS,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 214-222, 1979. 5 ref.

Descriptors: *Hydrologic data, *Data storage and retrieval, *Data acquisition, Rainfall rate, Streamflow, Storm runoff, Data processing.

Chapter 8 of Section B: Data Processing and Manipulation, provides an inventory of hydrological records digitized to date for the Cedara and De Hoek/Ntabamhlope Catchments, of data processed in collaboration with other agencies and of 'special storms'. Digitizing is an ongoing process in this project, the aim being to satisfy not only this project's constant demand for processed records, but also to be able to work with other hydrological research agencies on a collaborative and/or reciprocal basis in the endeavor to eventually understand more comprehensively than at present the rainfall runoff soil loss processes. (USGS)
W88-00955

SMALL CATCHMENT FLOOD SIMULATION BY THE HUGGINS MODEL AND THE SCS SYNTHETIC HYDROGRAPH,
Natal Univ., Pietermaritzburg (South Africa).
D. W. Cousens, and J. R. Burney.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 223-234, 1979. 3 fig, 1 tab, 6 ref.

Descriptors: *Catchment areas, *Hydrologic data, *Parametric hydrology, *Data processing, Flood flow, Flood forecasting, Mathematical models, Model studies, Storm runoff, Agricultural watersheds, Runoff plot, Flood hydrograph, Synthetic hydrology, Huggins model, Monke model.

Chapter 9 of Section C: Hydrologic Models and Techniques, is concerned with the test procedures and results obtained using both statistical and deterministic models and attempts to explain the two types. The performance of the Huggins and Monke Model was superior for complex storms while the SCS (the United States Soil Conservation Service) synthetic hydrograph proved more efficient for simple storms. (USGS)
W88-00956

SUGGESTED MODIFICATIONS TO THE SCS MODEL FOR IMPROVED ESTIMATIONS OF RUNOFF VOLUME,
Natal Univ., Pietermaritzburg (South Africa).
For primary bibliographic entry see Field 2E.
W88-00957

2B. Precipitation

MULTIDIMENSIONAL MODEL OF NONSTATIONARY SPACE-TIME RAINFALL AT THE CATCHMENT SCALE,
Princeton Univ., NJ. Water Resources Program.
For primary bibliographic entry see Field 2A.
W88-00040

NEAREST-NEIGHBOR METHODS FOR NONPARAMETRIC RAINFALL-RUNOFF FORECASTING,
American Telephone and Telegraph Co., Denver, CO.
For primary bibliographic entry see Field 2A.
W88-00041

USE OF WEIGHTED INTEGRAL VARIABLES TO DETERMINE THE RELATION BETWEEN RAINFALL INTENSITY AND STORM FLOW AND PEAK FLOW GENERATION,
Melbourne Univ., Parkville (Australia). School of Agriculture and Forestry.
For primary bibliographic entry see Field 2A.
W88-00043

SIMPLE WET-ONLY RAINFALL COLLECTOR,
Newcastle Univ. (Australia). Dept. of Geography.
H. A. Bridgman.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 3/4, p 257-263, April 1987. 1 fig, 2 ref, 2 append.

Descriptors: *Precipitation sampling, *Sampling, *Samples, *Rainfall sampling, *Rainfall collectors, *Acid rain, *Australia, *Economic aspects, Sample protection, Precipitation, Regression analysis, Conductivity, Hydrogen ion concentration.

A simple, inexpensive, event-actuated, and wet-only precipitation collector designed for use in a major acid precipitation project in the Hunter Region, New South Wales, Australia, is described. The sampler is designed for non-freezing conditions and is labor rather than material intensive. The collector meets requirements for efficiency, reliability and protection of the sample. Its major problem may be splash contamination from the funnel cover and motor housing. This can be minimized by regular cleaning during weekly servicing. The collector is durable with replaceable components and provides representative samples for chemical analysis. Components for the collector cost approximately $120.00. (Author's abstract)
W88-00097

DROUGHT IN AFRICA,
M. H. Glantz.
Scientific American SCAMAC, Vol. 256, No. 6, p 34-40, June 1987. 5 fig.

Descriptors: *Drought, *Africa, *Famine, *Precipitation, *Climates, *Atmospheric processes, *Topography, *Land use, Paleontology, Peru Ecuador Southern Oscillation, Irrigation, Education, Public policy, Policy making.

Searching for a single cause of African droughts is probably futile. There are many different regimes of climate resulting from different atmospheric processes and topographic features. There are also many different societies employing different pat-

terns of land use. The most popular conception of drought is that it is a meteorological event. Yet agricultural and hydrological drought also occur. The speculation about the causes of drought in Africa centers on both natural and human factors. Paleoenvironmental research findings show that both extended wet periods and extended dry periods have occurred in parts of sub-Saharan Africa for thousands of years. Drought appears to be an aperiodic phenomenon as well as a recurrent one. A strong correlation between Peru Ecuador Southern Oscillation events and rainfall in southeastern Africa has been seen. West African droughts may be better explained by sea-surface temperature variations in the Atlantic. Geophysical conditions possibly related to drought are discussed. The complex interactions of climatic variability and human activity are also considered. Drought by itself does not always determine whether there will be a famine. There is a high probability that a country with internal conflicts is at a considerable risk of famine if there is a drought. Although irrigation has been seen as a buffer to drought, it often has been ineffective. Other proposals for providing a buffer against drought include various schemes to modify climate and weather. One remedial step is a program of education and persuasion by agencies on the theme that drought is a major and recurring disruptive force with which policy makers must reckon. (Main-PTT)
W88-00101

CUMULATIVE EFFECTS OF SIMULATED ACID RAIN ON SOIL CHEMICAL AND MICROBIAL CHARACTERISTICS AND CONIFER SEEDLING GROWTH,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5C.
W88-00108

SOLENOID-OPERATED, VARIABLE INTENSITY RAINFALL SIMULATOR,
Georgia Agricultural Experiment Stations, Athens.
W. P. Miller.
Soil Science Society of America Journal SSJD4, Vol. 51, No. 3, p 832-834, May-June 1987. 2 fig, 11 ref.

Descriptors: *Simulated rainfall, *Rainfall simulation, Erosion, Plot studies, Microcomputers, Infiltrometer, Runoff.

A portable, variable-intensity, low-cost rainfall simulator is described for use in small pan runoff-erosion studies which can be adapted to larger plot studies for field use. Intensity is controlled by electrically operated solenoid valves into which wide square spray nozzles are fitted. The opening and closing of the solenoid valves, controlled via switches operated by a rotating cam or microcomputer, varies the intensity of rainfall from 0.0004 mm/s to approximately 0.024 mm/s, at 29 kPa water pressure. Coefficients of uniformity for 1 sq m plots under a single nozzle are 90 to 95% and 85 to 90% for 1- by 3-m field plots using a three nozzle system. Kinetic energy of the rainfall, determined from drop size distributions, is about 23 J/sq m/mm, which is within the range of natural rainfall. (Author's abstract)
W88-00109

INTER-STORM COMPARISONS FROM THE OSCAR HIGH DENSITY NETWORK EXPERIMENT,
For primary bibliographic entry see Field 5B.
W88-00120

SIMPLIFIED WET-ONLY AND SEQUENTIAL FRACTION RAIN COLLECTOR,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-00121

DIAGNOSTIC ANALYSIS OF TWO INTENSE MONSOON DEPRESSIONS OVER AUSTRALIA,
Bureau of Meteorology, Melbourne (Australia).
N. E. Davidson, and G. J. Holland.
Monthly Weather Review MRWEAB, Vol. 115, No. 2, p 380-392, February 1987. 13 fig, 27 ref.

Descriptors: *Precipitation, *Monsoons, *Precipitation intensity, *Meteorology, *Climatology, Temperature, Rainfall, Wind, Dewpoint, Australia, Rainstorms, Clouds.

Analyses of mean sea level pressure, wind, temperature and dewpoint were used to study the life cycles of two intense, heavy-rain producing monsoon depressions over northern Australia. Two aspects were considered: (a) the large-scale forcing, using both synoptic flow field changes and angular momentum budgets, and (b) the role of convective and stratiform clouds, using kinematic and thermodynamic budgets. For each situation, the Northern Hemisphere circulation became favorable well prior to genesis. The short-term trigger for development is the strengthening of the Southern Hemisphere subtropical ridge at the surface and an amplifying upper-level trough and subtropical jetstreak to the southwest of the formation point. The outer region structure of these monsoon depressions is considerably similar to that of a tropical cyclone, even though the systems develop over land. During development, maximum convective heating occurs at middle levels and within a region of already high cyclonic vorticity. Evidence suggests that the cloud population is mostly comprised of deep cumulonimbus clouds, middle-level stratiform cloud and shallow cumulus. (Author's abstract)
W88-00122

GENERATION OF CONVECTIVE STORMS OVER THE ESCARPMENT OF NORTHEASTERN SOUTH AFRICA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. Garstang, B. E. Kelbe, G. D. Emmitt, and W. B. London.
Monthly Weather Review MRWEAB, Vol. 115, No. 2, p 429-443, February 1987. 17 fig, 2 tab, 11 ref.

Descriptors: *Precipitation, *Convective precipitation, *Rainstorms, *South Africa, *Meteorology, *Climatology, *Storms, *Orographic precipitation, Rainfall, Storms, Advection, Diurnal variation.

The generation of convective storms over the escarpment of the northeastern region of South Africa was examined in terms of synoptic-, meso-, and local-scale forcing. Severe storm days are defined and contrasted with no-storm days over a 5-year period. Storms are associated with midtropospheric troughs in the westerlies which interact with a major topographic boundary. A mesoscale capping inversion exists in the lee of the escarpment on storm days. Formation of the inversion is enhanced by a diurnal shift in wind direction across the escarpment. The subsidence inversion anchored to the escarpment is deepened during the day by the advection of the daytime mixed layer off an elevated heat source. Development of severe storms occurs selectively in time and space where easterly low-level moist inflow can penetrate the capping inversion. There appears to be a critical relationship between the larger-scale synoptic circulations and the meso- and local-effects for severe storms to develop. (Author's abstract)
W88-00123

THUNDERSTORM GENESIS ZONES IN THE COLORADO ROCKY MOUNTAINS AS DETERMINED BY TRACEBACK OF GEOSYNCHRONOUS SATELLITE IMAGES,
Air Force Geophysics Lab., Hanscom AFB, MA.
R. M. Banta, and C. B. Schaaf.
Monthly Weather Review MRWEAB, Vol. 115, No. 2, p 463-476, February 1987. 10 fig, 2 tab, 39 ref.

Descriptors: *Orographic precipitation, *Precipitation, *Rainstorms, *Rocky Mountains, *Remote sensing, Precipitation intensity, Mountain thunderstorms, Colorado.

Mountain thunderstorms often originate in preferred regions of the topography, as shown qualitatively by pilot reports and more quantitatively by meteorological radar, satellite, and lightning detector studies. To further investigate the phenomenom of mountain thunderstorm initiation, time sequences of GOES imagery were used to locate storms and to trace them back to their points of origin. Using three summers of data from days which started out clear, over 600 storms in the mountains of Colorado and New Mexico were analyzed. The origin points were plotted on a terrain map and contours of initiation frequency were drawn to identify regions with a high likelihood of producing thunderstorms. Initiation sites were found to cluster into identifiable geographical locations or genesis zones, consistent with findings based on the other data sources. When cloud propagation effects were taken into account, the locations of these genesis zones were also consistent with the locations of clustering regions found in the other studies. There were also regions which thunderstorm initiations tended to avoid, including such broad mountain bases as South Park and the San Luis Valley, and such wide river valleys as the Gunnison and Colorado. The data was also stratified by a ridgetop wind direction. Many of the genesis zones were active only under certain wind regimes. For example, in the southern Sangre de Cristo Mountains, storm initiations tended to occur to the lee of the range under southwesterly, northwesterly and southeasterly flow at ridgetops. Knowledge of the prevailing flow directions under which genesis zones were active allowed the determination of mechanisms which contributed to storm initiation. (Author's abstract)
W88-00124

PREDICTABILITY EXPERIMENTS USING A HIGH-RESOLUTION LIMITED-AREA MODEL,
National Center for Atmospheric Research, Boulder, CO.
R. Errico, and D. Baumhefner.
Monthly Weather Review MRWEAB, Vol. 115, No. 2, p 488-504, February 1987. 14 fig, 22 ref.

Descriptors: *Precipitation, *Precipitation intensity, *Weather patterns, *Weather forecasting, *Model studies, Computer models, Mesoscale models, Gravity waves, Error analysis, High-resolution models.

Limited-area mesoscale models with prescribed lateral boundaries do not exhibit the same predictability error growth as observed in large-scale (global) models for weather prediction. New methods of limited-area initialization and spectral analysis indicate that several model properties act to restrict the growth of perturbations. These include: the projection of initial perturbations onto gravity waves which interact only weakly with other, more significant motions; the 'sweeping out' of errors by correct or perfect lateral boundaries; and the reduction of differences by subgrid dissipation. This last property suggests that there is a strong dynamical forcing of small scales by much larger scales, so that this forcing is only weakly affected by typical, small-scale perturbations in this model. New experiments imply that some quasi-geostrophic components of the forecasts, away from the inflow boundaries, exhibit local error doubling times of approximately one day within active baroclinic regions. (Author's abstract)
W88-00125

SATELLITE-OBSERVED CHARCTERISTICS OF WINTER MONSOON CLOUD CLUSTERS,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
M. Williams, and R. A. Houze.
Monthly Weather Review MRWEAB, Vol. 115, No. 2, p 505-519, February 1987. 18 fig, 2 tab, 18 ref.

Descriptors: *Precipitation, *Monsoons, *Rainstorms, *Satellite technology, *Remote sensing, Storms, Cloud clusters, Winter storms, Indonesia, Model studies, Bornea, Diurnal variation.

An objective algorithm was devised which is capable of locating cloud clusters at the point of initiation, tracking them to the point of dissipation and thereby accumulating statistics on their size distributions and preferred geographical locations and times of occurence. The technique is able to account for periods of growth, mergers, splits and decay, which take place during the lifetime of an individual cluster. It is used to derive statistics on cloud clusters observed during the Winter Monsoon Experiment, which was conducted in the region of the 'maritime continent,' near Borneo, in December, 1978. The size distribution of the clusters identified and tracked shows that by far most of the cumulative cloud cover was accounted for by a few very large clusters. This result implies that the vertical distribution of diabatic heating in the region of the experiment was strongly influenced by dynamical and radiative processes in the widespread stratiform cloud and precipitation areas that typify very large clusters. A pronounced diurnal cycle was characterized by a preference for the very large clusters to reach the middle of their lifetime over the sea during morning. Monsoon 'surge' conditions over the South China Sea also strongly favored the occurence of large clusters over the water north of Borneo. (Author's abstract)
W88-00126

SYNOPTIC AND MESOSCALE ASPECTS OF AN APPALACHIAN ICE STORM ASSOCIATED WITH COLD-AIR DAMMING,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
G. S. Forbes, R. A. Anthes, and D. W. Thomson.
Monthly Weather Review MRWEAB, Vol. 115, No. 2, p 564-591, February 1987. 21 fig, 6 tab, 56 ref.

Descriptors: *Freezing rain, *Precipitation, *Storms, *Sleet, Hail, *Appalachian mountains, *Ice storms, Mesoscale effects, Synoptic effects, Temperature, Wind.

An ice storm of moderate severity occurred along the east slopes of the Applachians on 13-14 January 1980. Though surface temperatures were initially below freezing in most of this region, objective guidance indicated that large-scale warm advection would render the atmosphere conducive to rain. Warm advection did occur above about 900 mb, but below this level warm advection was prevented by a cold wedgeshaped ridge of high pressure which became entrenched along the east slopes. Temperatures in the lowest 0.5-1 km remained below freezing and an ice storm resulted. This case study documents the evolution of the wedge ridge and the temperature and wind fields associated with it. Comparisons were made between the evolution of these fields within the quasi-stationary wedge ridge (a weather regime known as cold-air damming) and their evolution during the preceding period, when the pressure ridge was progressing eastward across the Midwest. The process controlling the changes of temperature in these regimes was analyzed; cold advection and upslope flow maintained the cold dome. Cross sections are used to present detailed analyses of the vertical structure and evolution of the temperatures and winds within the damming region. Interesting features include the development of an 'extended coastal front'-the sloping inversion separating the trapped cold dome from the warm onshore flow above, a jet parallel to the mountain at low levels, and an enhanced flow over the mountain near its crest. Apparently due to the lack of vertical resolution sufficient to capture such features, operational numerical models exhibited substantial errors in this case. (Author's abstract)
W88-00127

PRELIMINARY INVESTIGATION OF A RELATIONSHIP BETWEEN SOUTH AMERICAN SNOW COVER AND THE SOUTHERN OSCILLATION,
Nebraska Univ.-Lincoln. Dept. of Geography.
R. S. Cerveny, B. R. Skeeter, and K. F. Dewey.
Monthly Weather Review MRWEAB, Vol. 115, No. 2, p 620-623, February 1987. 3 fig, 2 tab, 17 ref.

Descriptors: Descriptors:*Precipitation, *Snow, *Remote sensing, *Climatology, Weather, *South America, Southern oscillation, Snow cover, Temperature.

South American snow cover area during the May-October snow season was correlated significantly with the winter Southern Oscillation index (SOI) values of the same year. The relationship is inverse; periods of low SOI values are associated with extensive South American snow cover while periods of high SOI values occur during years of diminished snow cover. The movements of the Pacific anticyclone and the midlatitude westerlies and subsequent changes in precipitation and temperature patterns were discussed in an analysis of this relationship. There is evidence that the strength and direction of the relationship between the SOI and snow cover may vary with latitude and be limited to the region north of 45 deg S. This styudy suggests that increased snow cover between 20 deg and 40 deg is primarily influenced by a weakening of the subtropical Pacific high and an expansion of the midlatitude westerlies into the region. (Master-PTT)
W88-00128

RAINFALL VARIABILITY IN EQUATORIAL AND SOUTHERN AFRICA: RELATIONSHIPS WITH SEA SURFACE TEMPERATURES ALONG THE SOUTHWESTERN COAST OF AFRICA,
Florida State Univ., Tallahassee. Dept. of Meteorology.
S. E. Nicholson, and D. Entekhabi.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 26, No. 5, p 561-578, May 1987. 16 fig, 2 tab, 61 ref. NSF Grant No. ATM-8212781.

Descriptors: *Rainfall, *Sea surface temperature, *Water temperature, *Meteorology, *Climatology, *Coastal waters, *Africa, Surface water, Upwelling, Benguela coast, Time series analysis, Mathematical studies.

Sea water temperature (SST) fluctuations in the upwelling region along the Benguela coast were analyzed and its relationship to rainfall variability both along the coast and throughout equatorial and southern Africa were studied. The analysis incorporates compositing and time series analysis. Coastal rainfall is markedly enhanced during warm-water years and suppressed during cold-water years. The effects are strongest in March and April; at some stations, March totals of 50 mm in cold-water years contrast with 200 to 400 mm in March of warm-water years. Spectral analysis shows the variability of SSTs to be most pronounced on time scales of 5 to 6 years, and strong relationships with rainfall throughout equatorial and southern Africa are evident on this time scale. In coastal regions there may be some degree of direct local forcing of rainfall anomalies via SST anomalies, but the temporal and geographical patterns of the relationship suggest that in general, both SSTs and rainfall probably respond to common atmospheric forcing mechanisms. (Author's abstract)
W88-00144

VARIABILITY IN UNITED STATES CLOUDINESS AND ITS RELATION TO EL NINO,
National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
J. K. Angell, and J. Korshover.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 26, No. 5, p 580-584, May 1987. 5 fig, 2 tab, 91 ref.

Descriptors: *Cloud cover, *Clouds, *El Nino, *Climatology, *United States, Sunshine duration, Correlation analysis, Regression analysis, Seasonal variation, Sea surface temperature, Surface water, Temperature.

Based on linear regression, during 1950-85 the year-average, United States cloudiness (defined here as an average of cloud amount and sunshine duration) increased by a significant 0.8% per decade, with the increase greatest in the South Central region (1.3% per decade). During 1970-85, however, the United States cloudiness increased by only 0.4% per decade, a nonsignificant amount. Over the 36-year interval, most of the cloudiness increase was in autumn (2.1% per decade for the contiguous United States), but during 1970-85 the cloudiness increase was similar (about 0.4% per decade) in all four seasons. For the United States as a whole, cloudiness has been above average at the time of strong El Ninos, such as those in 1972-73 and 1982-83, but often below average at the time of weaker El Ninos. As a consequence, over the 36-year interval the maximum correlation between seasonal sea surface temperature (SST) (in the region 0 degrees-10 degrees S, 180 degrees-80 degrees W) and the United States cloudiness is only 0.26 (cloudiness leading this SST by about one season), just significant at the 5% level taking account of serial correlation. The correlation (r) has been largest in southwestern (r=0.26) and north central (r=0.30) regions of the United States and least in the northeastern region (r=0.09). (Author's abstract)
W88-00145

MICROPHYSICAL AND RADAR OBSERVATIONS OF SEEDED AND NONSEEDED CONTINENTAL CUMULUS CLOUDS,
Weather Bureau, Bethlehem (South Africa).
T. W. Krauss, R. T. Bruintjes, J. Verlinde, and A. Kahn.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 26, No. 5, p 585-606, May 1987. 11 fig, 4 tab, 38 ref.

Descriptors: *Clouds, *Cloud seeding, *Remote sensing, *Cumulus clouds, Cloud liquid water, Microphysical observations, Radar, Weather modification, Weather, South Africa, Ice, Dry ice, Silver iodide, Particle size, Entrainment.

Controlled cloud seeding experiments were conducted near Bethlehem, South Africa during the summer of 1984-85. The experimental unit was the semi-isolated cumulus congestus cloud. Microphysical measurements were obtained by three instrumented aircraft flying in stacked formation. Radar observations were made by a 5-cm wavelength radar performing volume scans at 5-minute intervals. A three-way randomization scheme was used to seed clouds near the -8 degrees C level with either dry ice pellets, silver iodide pyrotechnics, or a placebo (no seed) treatment. Strict cloud selection criteria, based on the measurements made during an initial inspection penetration, assured the treatment of clouds in their developing stages as their tops rose up through the -10 degrees C level. A total of 60 clouds were chosen and treated. Using ice crystal measurements, mostly above the seeding level, it was demonstrated that some cumulus clouds are modified by the injection of either dry ice or silver iodide. High ice concentrations were produced and the evolution of the ice particle size distribution is consistent with a rain enhancement hypothesis involving an artificially induced ice embryo process. However, the liquid water contents decayed rapidly, primarily due to entrainment, and in the majority of the seeded cases precipitation particles formed due to low-density accretion onto aggregates resulting in little or no precipitation at the ground. The dry ice- and silver iodide-seeded clouds that echoed had significantly higher maximum 1-km average ice concentrations than placebo clouds. Approximately 67% of the dry ice-treated clouds, 63% of the silver iodide-treated clouds, and 45% of the placebo clouds produced radar echoes >10 dBZ. The dry ice-seeded clouds that echoed had significantly higher maximum cell heights than the placebo cells and the silver iodide-seeded cells. When the test cloud data were stratified according to diameter, a positive association existed between seeding and number of clouds that echoed. Wider clouds responded more favorably to seeding, presumably because they were affected less by entrainment. (Author's abstract)
W88-00146

BUDGETS OF WATER VAPOR IN THE UNSTABLE BOUNDARY LAYER OVER RUGGED TERRAIN,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. P. Kustas, and W. Brutsaert.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 26, No. 5, p 607-620, May 1987. 8 fig, 5 tab, 29 ref. NSF Grant No.ATM8115713.

Descriptors: *Water vapor, *Inversions(Atmosphere), *Boundary layers, *Meteorology, *Atmospheric water, Hills, Mathematical studies, Mathematical equations, Switzerland, Humidity, Specific humidity, Surface evaporation.

Inversion fluxes of water vapor are calculated for 11 clear days using profile data from a sequence of radio soundings over hilly terrain in the Pre-Alpine region of Switzerland. The relationships between the mixed layer and inversion layer gradients of specific humidity, and the inversion and surface fluxes of water vapor together with other turbulence parameters were investigated. The mean mixed layer gradient, appears to be fairly well related to the inversion flux of water vapor. There is also evidence that a relationship exists between the gradient in the inversion layer, and an eddy diffusion parameter. The atmospheric water vapor budget below the inversion was tested with the gathered data as a means of determining surface evaporation. Transport in the mixed layer appears to be more strongly affected by mechanical-type than by convective-type disturbances. (Author's abstract)
W88-00147

ADVANCES IN THE IDENTIFICATION AND ANALYSIS OF ORGANIC POLLUTANTS IN WATER, VOLUME 2.
For primary bibliographic entry see Field 2A.
W88-00406

ASSESSMENT OF SATELLITE RAIN ESTIMATES FOR LARGE-SCALE, OPERATIONAL USE,
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Weather Research and Modification.
C. G. Griffith, and J. A. Augustine.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-143131. Price codes: A05 in paper copy, A01 in microfiche. NOAA Technical Memorandum ERL OWRM-17, October 1982. 84 p, 21 fig, 3 tab, 13 ref, 2 append.

Descriptors: *Rainfall, *Model studies, *Satellite technology, Infrared imagery, Data acquisition, Remote sensing, Precipitation, Rain, Rain gages, Convection, Data collections, Meteorological data collections, Temporal distribution, Spatial distribution, Isohyets.

The feasibility of using a satellite rain estimation method to operationally estimate convection rainfall over large areas and for long time scales was estimated for the central third area of the United States (from the Rocky Mountains to the Mississippi River and from South Dakota to central Texas). A month of rainfall (August 1979) was estimated from GOES infrared satellite data. Comparisons were made between gage data for the month and for three individual days. Satellite rain estimates for the month and for the three days generally showed better correspondence with the gage data in the eastern part than in the western part of the array. This may be due to the effect of the Rocky Mountains on convection. The sparsity of the upper-air stations limited the effectiveness of the model adjustment factors. The adjustment factors derived from a one-dimensional cumulus cloud model provided the best adjustment out of the five tested. The derived isohyets are sensitive to the temporal frequency of the data. Computation time may be reduced by using the streamlined version of the technique. (Geiger-PTT)
W88-00637

NUMERICAL SIMULATION OF A POSSIBLE FREEZING AND SHEET FORMATION MECHANISM FOR BARIUM CLOUD STRIATIONS,
Naval Research Lab., Washington, DC.
S. T. Zalesak, J. A. Fedder, and S. L. Ossakow.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-121087. Price codes: A03 in paper copy, A01 in microfiche. NRL Memorandum Report 4919, October 25, 1982. 35 p, 4 fig, 11 ref.

Descriptors: *Mathematical models, *Barium clouds, *Simulation, *Computer models, Computer programs, Ionospheric plasma clouds, Gradient drift instability, Plasma clouds.

A possible mechanism is presented for the 'freezing' or apparent freezing, of barium cloud striations and for the formation of long thin sheets of barium on the leading edge of the cloud. The essence of the model is that the finite Pedersen mobility of the barium ions allows them to separate from the electron cloud. The barium is replaced in the electron cloud by the ions constituting the ambient ionosphere, which are compressed up to the required densities by their own Pedersen mobility. In the process of exiting the electron cloud, the barium is expanded and hence attains a density lower than when it coexisted with the electron cloud. For many ionospheric parameters the barium will have in effect left the region of further structuring, which will still be proceeding the electron cloud. As the barium leaves the electron cloud, it forms a long thin sheet of lower density barium, one side of which is considerably steeper than the other, which extends from the leading (nonstructuring) edge of the cloud. An observer watching only the barium would conclude that the cloud had frozen. Further, the electron cloud itself may decay if the ions coexisting with it are subject to a fast recombination chemistry. (Author's abstract)
W88-00661

CONTINUING DESIGN WORK FOR THE SIERRA COOPERATIVE PILOT PROJECT: INTERIM REPORT NO. 5,
North American Weather Consultants, Salt Lake City, UT.
R. D. Elliott, D. A. Griffith, J. A. Flueck, and J. F. Hannaford.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-164236. Price codes: A08 in paper copy, A01 in microfiche. Report No. SLWM-82-4, November 1982. 146 p, 28 fig, 11 tab, 48 ref, 5 append. Contract No. 7-07-83-V0008.

Descriptors: *Precipitation, *Artificial precipitation, *Cloud seeding, *Weather modification, Convective precipitation, Rainfall, Model studies, Clouds, Cloud physics.

Research activities concerned with the continuing design work on the Sierra Cooperative Pilot Project (SCPP) are discussed. Simulation work of potential impacts of seeding in various observed conditions in the SCPP area was conducted through the utilization of a computer model (GUIDE) developed specifically for the SCPP. One version of GUIDE simulates the orographic water balance of SCPP storms. Another version simulates seeding signature (either aerial or ground releases) first in the clouds and ultimately the fallout of precipitation sized particles to the ground. This model, which was originally formulated in BASIC computer language, was converted to FORTRAN to provide quicker running times and transferability of the model to other users. (Author's abstract)
W88-00894

TREND SURFACE ANALYSIS TECHNIQUE FOR AUTOMATED MAPPING OF RAINFALL STATISTICS DERIVED FROM POINT MEASUREMENTS,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 253-274, 1979. 5 fig, 1 tab, 25 ref.

Descriptors: *Planning, *Rainfall distribution, *Networks, Rainfall rate, Data processing, Hydrologic data, Spatial distribution, Temporal distribution, Rain gages, Geomorphology, Rainfall-runoff relationship, Natal, Trend surface analysis.

Chapter 11 of Section C: Hydrological Models and Techniques, aims at illustrating the practical considerations that have to be borne in mind when trend surfaces are fitted and used for estimations of point and areal rainfall. The technique itself is first examined before practical considerations in the application of the technique are discussed. The chapter concludes with a review of its application in hydrology. (USGS)
W88-00958

2C. Snow, Ice, and Frost

COUPLED THERMOMECHANICAL RESPONSE OF AN AXISYMMETRIC COLD ICE SHEET,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
K. Hutter, S. Yakowitz, and F. Szidarovszky.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1327-1339, July 1987. 9 fig, 4 tab, 21 ref. NSF Contract DPP 8219439.

Descriptors: *Rheology, Glaciology, *Ice sheets, *Ice, *Model studies, *Mechanical energy, *Thermal energy, Differential equations, Mathematical studies, Mathematical models, Mathematical equations, Temperature, Stress fields.

A detailed thermomechanical flow model for ice sheets having a radially symmetric geometry uses governing relations that are derived from first principles of physics. The interactive aspects of mechanical and thermal energy are taken into account. The resulting model is a nonlinear partial differential equation relating the temperature, velocity, and stress fields. Boundary conditions of accumulation rate, geothermal flux, sliding laws, and surface temperatures are specified, and the model determines a steady state response in terms of ice sheet profile and internal temperatures, velocities, and stresses. The computational methodology is described for numerically determining solutions from which one can assess the credibility of the model itself, and to the extent that it is credible, examine effects such as perturbation of external temperatures, accumulation rates, and so forth. (Author's abstract)
W88-00044

SYNOPTIC AND MESOSCALE ASPECTS OF AN APPALACHIAN ICE STORM ASSOCIATED WITH COLD-AIR DAMMING,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W88-00127

PRELIMINARY INVESTIGATION OF A RELATIONSHIP BETWEEN SOUTH AMERICAN SNOW COVER AND THE SOUTHERN OSCILLATION,
Nebraska Univ.-Lincoln. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W88-00128

DEPOSITIONAL MODEL FOR OUTWASH, SEDIMENT SOURCES, AND HYDROLOGICAL CHARACTERISTICS, MALASPINA GLACIER, ALASKA: A MODERN ANALOG OF THE SOUTHEASTERN MARGIN OF THE LAURENTIDE ICE SHEET,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2J.
W88-00157

MARINE CIRCULATOR,
For primary bibliographic entry see Field 5G.
W88-00502

INVESTIGATION OF GROWTH INSTABILITIES OF THE ICE-WATER INTERFACE BY LIGHT SCATTERING SPECTROSCOPY,
Y. Yeh.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-209409/AS. Price codes: A03 in paper copy, A01 in microfiche. Final Report, (1982). 40 p, 2 tab, 15 fig, 36 ref. Contract No. 14-34-0001-9435.

Descriptors: *Ice-water interfaces, *Crystal growth, *Spectroscopy, *Model studies, *Ice formation, Ice, Ice-brine systems, Crystals, Spectral analysis, Models, Freezing.

The growth of a pure single crystal of ice into its own melt under a temperature gradient leads to enhanced scattering of light at the ice-water interface. This anomalously intense scattering of light develops when the crystal growth velocity exceeds 0.6 microns/sec. Even though the scattering phenomenon occurs as soon as the dynamic stationary state interface has developed, the ice phase which has been overtaken by this surface exhibits no anomalous scattering. Experiments have been conducted to measure the angular dependence of decay time associated with scattering and the long term development of this interfacial phenomenon. Scattering does not occur in the liquid phase under given supercooling and temperature gradient if the interface is absent. Substances which can disrupt interfacial ice growth have been selected by detailed investigations of their ice growth inhibition capabilities. A model postulating that this phenomenon is related to the growth and dissipation of spontaneous surface defects has been explored. (Author's abstract)
W88-00535

2E. Streamflow and Runoff

RISK ANALYSIS AND TIME-DEPENDENT FLOOD MODELS,
Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Wasserwirtschaft.
H. P. Nachtnebel, and F. Konecny.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 295-318, June 15, 1987. 8 fig, 4 tab, 18 ref, 2 append.

Descriptors: *Model studies, *Flood peak, *Floods, *Hydrologic risk, *Risk analysis, Seasonal variation, Model testing, Austria, Flood discharge, Flood hydrographs, Mathematical equations, Mathematical studies.

In a stochastic model for the partial duration series (PDS) of floods the occurrence of flood peaks is modelled by an inhomogeneous Poisson process where a number of events in a given time interval exhibits an annual cycle. The magnitude of events above the threshold is assumed to be distributed exponentially with a coefficient also exhibiting an annual cycle. The hydrologic risk associated with this model is also evaluated. The evaluation procedure is based directly on the extreme value process of the PDS. The density function of the design discharge arising from uncertainties in the parameters was obtained for two versions of the model. In the first, identically and independently distributed flood magnitudes are assumed, while in the second, a seasonal dependency in the distribution of the exceedances is allowed for. The models were applied to a series of daily discharge values of a gauging station on the river Gail in Carinthia, in the southern part of Austria. Because the model incorporates the seasonal occurrence of the flood events, it can be used to identify advantageous periods for construction works. In the case examined, the first 250 days in a year are recommended for accomplishing civil engineering works. It is suggested that this technique could also be incorporated into reservoir operation rules for improved flood protection. (Wood-PTT)
W88-00007

EFFECTS OF BANK STORAGE AND WELL PUMPING ON BASE FLOW, CARMEL RIVER, MONTEREY COUNTY, CALIFORNIA,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. M. Kondolf, L. M. Maloney, and J. G. Williams.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 351-369, June 15, 1987. 10 fig, 4 tab, 20 ref. DOE Contract DE-AC05-840R21400.

Descriptors: *River flow, *Bank storage, *Pump wells, *Water level, *Surface-groundwater relationships, *Base flow, *Groundwater level, Alluvial rivers, Rivers, Permeability, Storage, Floods, Hydraulic gradient, Drainage, Carmel River, California, Aquifers, Groundwater depletion, Water table, Pumping.

Bank storage contributions to base flow may be important on alluvial rivers with highly permeable bank material, such as the lower Carmel River, Monterey County, California. The recharge phase of bank storage occurs during flood stage in the river when a hydraulic gradient exists from the river into the banks. In general, discharge from bank storage is most important on the recession limb of individual floods, with most stored water typically being discharged within 2-3 flood periods. As the river stage continues to fall, a hydraulic gradient from the banks to the river is maintained and stored water drains from the banks. On the Carmel River, the seasonal recession limb provides conditions of gradually declining stage over several months. In 1982, a moderately wet year, bank storage contributions were detected two months after the last peak flow of the winter rainy season, during a period of critical importance to steelhead trout and probably to riparian vegetation. However, in 1983, an extremely wet year, bank storage was undetectable two months after the season's last peak flow, probably because the sustained base flow from the upper basin overwhelmed the more transient bank storage contribution. Groundwater withdrawal from the alluvial aquifer locally lowered the water table so that streamflow was influent to the banks in the reach of major pumping wells. This effect was striking in its persistence, whether the Carmel River was gaining or losing overall in its alluvial reach. Pumping rates were roughly comparable to flow losses across the well field. (Author's abstract)
W88-00010

SIMPLE RECURSIVE FORMULA TO REPLACE WILSON'S GRAPHICAL LAKE ROUTING,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7C.
W88-00011

ESTIMATION OF FLOOD FREQUENCY: AN EVALUATION OF TWO DERIVED DISTRIBUTION PROCEDURES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W88-00042

INDIRECT METHOD FOR DETERMINATION OF THE PARAMETERS OF FLOOD PLAIN AQUIFERS,
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
For primary bibliographic entry see Field 2F.
W88-00129

PEATLAND HYDROLOGIC IMPACT MODEL: DEVELOPMENT AND TESTING,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 4C.
W88-00130

RESONANT REFLECTION OF WATER WAVES IN A LONG CHANNEL WITH CORRUGATED BOUNDARIES,
Cornell Univ., Ithaca, NY. High-Voltage Lab.
P. L.-F. Liu.
Journal of Fluid Mechanics JFLSA7, Vol. 179, p 371-381, June 1987. 3 fig, 8 ref.

Descriptors: *Channels, *Wave equations, *Wave reflection, *Waves, Wave propagation, Wave height, Wavelengths, Boundary conditions, Boundaries, Mathematical equations, Mathematical studies.

A one-dimensional wave equation is derived for water-wave propagations in a long channel with corrugated boundaries. The amplitude and the wavelength of boundary undulations are assumed to be smaller than, and in the same order of magnitude as, the incident wavelength, respectively. When the Bragg reflection condition (i.e., the wavenumber of the boundary undulations is twice that of the incident wavenumber) is nearly satisfied, significant wave reflection could occur. Coupled equations for transmitted and reflected wave fields were derived for the near resonant coupling. The detuning mechanism is attributed to the slight deviation in the wavenumber of the corrugated boundaries from the Bragg wavenumber. Analytical solutions were obtained for the cases where the boundary undulations are within a finite region. The theory was applied to the design of a harbor resonator,f and shown to be an attractive alternative to the conventional quarter wavelength harbor resonator. This concept of resonance reflection is limited to small-amplitude waves in an intermediate water depth. It can, however, be extended to the shallow-water limit and include nonlinear effects. (Wood-PTT)
W88-00148

RESPONSE OF QUATERNARY FLUVIAL SYSTEMS TO DIFFERENTIAL EPEIROGENIC UPLIFT: AGUAS AND FEOS RIVER SYSTEMS, SOUTHEAST SPAIN,
Liverpool Univ. (England). Dept. of Geography.
A. M. Harvey, and S. G. Wells.
Geology GLGYB, Vol. 15, No. 8, p 689-693, August 1987. 4 fig, 26 ref.

Descriptors: *Quaternary Fluvial systems, *Aguas river, *Feos river, *Southeast Spain, *Differential epeirogenic uplift.

The effects of differential uplift of the landmass on the direction of the flows of the rivers Aguas and Feos in southeast Spain are discussed. Because of regional uplift, during late Pliocene-early Pleistocene time, of the depositional marine surface the river flowed in the a southward direction. This drainage direction was disrupted when the Alhamilla-Cabrera Sierras and the Sorbas basin were uplifted differentially relative to the surrounding basins. The ancestral Feos drainage responded by incision across the uplift through a combination of superimposition and antecedence. Differential uplift of the Sorbas basin enhanced headward erosion of strike-oriented drainages and promoted capture of the ancestral Feos drainage by the Rio de Aguas during the late Pleistocene. Stratigraphic relations and soil development indicate that epeirogenic uplift and local tectonics, together with climatic fluctuations, have influenced the development of the drainage systems throughout the Quaternary. (Ray-PTT)
W88-00160

ROLE OF TREE DAMS IN THE CONSTRUCTION OF PSEUDO-TERRACES AND VARIABLE GEOMORPHIC RESPONSE TO FLOODS IN LITTLE RIVER VALLEY, VIRGINIA,
Southern Illinois Univ. at Carbondale. Dept. of Geology.
R. C. Kochel, D. F. Ritter, and J. Miller.
Geology GLGYB, Vol. 15, No. 8, p 718-721, August 1987. 5 fig, 16 ref.

Descriptors: *Tree dams, *Floods, *Little River valley, *Virginia, *Geomorphology, *Geological terraces, *Flood plain morphology, Bank erosio, Erosion, Gravel, Detritus, River banks, Dams, Channels, Flood channels.

Geomorphic response to a 1985 flood in the Little River Valley, northern Virginia was compared with the largest historic flood in 1949 in the same valley. The primary geomorphic activity during

the 1985 flood was severe bank erosion and channel-gravel deposition rather than the debris flow and avalanching of the 1949 event. An unusual and widespread phenomenon of the recent flood was that large trees eroded and transported by the flood water were aligned parallel to the river banks and, at isolated sites, were braced and stacked against trees standing on the floodplain. Lateral barriers or dams created from these displaced trees allowed the channel to be locally aggraded above the level of the floodplain. In these reaches, little, if any, river gravel was deposited on the floodplain, even though the adjacent channel floor was raised well above that surface. The river has now shifted around the filled segments, leaving flat, isolated surfaces, underlain by channel gravel, standing above the level of the modern floodplain. These may be mistaken features for terraces after they become vegetated and the tree bracing the gravels decay. Interpreting these surfaces to be terrace remnants would thus lead to a faulty reconstruction of geomorphic history in the Little River valley and other valleys where floodplain morphology is controlled by infrequent flood events. (Author's abstract)
W88-00161

EFFECTS OF MAINSTREAM DAMS ON PHYSICOCHEMISTRY OF THE GUNNISON RIVER, COLORADO,
Montana Univ., Bigfork. Biological Station.
For primary bibliographic entry see Field 6G.
W88-00341

STATUS OF THE COLORADO RIVER ECOSYSTEM IN GRAND CANYON NATIONAL PARK AND GLEN CANYON RECREATIONAL AREA,
Museum of Northern Arizona, Inc., Flagstaff.
For primary bibliographic entry see Field 6G.
W88-00346

CHARACTERIZATION OF YAMPA AND GREEN RIVER ECOSYSTEMS: A SYSTEMS APPROACH TO AQUATIC RESOURCE MANAGEMENT,
Wyoming Game and Fish Dept., Cheyenne.
For primary bibliographic entry see Field 2H.
W88-00348

DESCRIPTION AND ASSESSMENT OF THE RAFT RIVER LOTIC SYSTEM IN THE VICINITY OF THE RAFT RIVER GEOTHERMAL AREA,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-00484

SECONDARY FLOW IN ESTUARIES DUE TO THE CURVATURE OF THE MAIN FLOW AND TO THE ROTATION OF THE EARTH AND ITS DEVELOPMENT,
Technische Hogeschool Delft (Netherlands).
R. Booij, and J. P. T. Kalkwijk.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-146597. Price codes: A03 in paper copy, A01 in microfiche. Report No. 9-82, October 1982. 38 p, 7 fig, 7 ref.

Descriptors: *Flow characteristics, *Flow, *Coriolis force, Flow channels, Tidal currents, Water currents, Tidal effects, Tidal hydraulics, Alluvium.

In tidal channels the flow pattern has a dominant influence on the morphology of an alluvial bottom. To predict bottom changes as caused by the flow a detailed description of the flow is necessary. In particular the deviations from the main flow, the so-called secondary flow, are important, as they give rise to bottom slopes transverse to the main flow. In this report the secondary flow, as typical for estuaries as the eastern Scheldt, is considered. (Author's abstract)
W88-00487

CONTINUOUS SYNTHESIS OF RUNOFF FROM THE KAWISHIWI RIVER BASIN IN NORTHEASTERN MINNESOTA BY THE RIVAL HYDROLOGIC MODEL,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. K. Bogart, and C. E. Bowers.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201117/AS. Price codes: A08 in paper copy, A01 in microfiche. External Memorandum No. 191, St. Anthony Falls Hydraulic Laboratory, Sept. 1986. 147 p, 24 fig, 4 tab, 7 ref, append. Project No. OWRT B-161-Minn (2). Contract No. 14-34-0001-1237.

Descriptors: *Model studies, *Hydrologic models, *Hydrologic simulation, *Continuous synthesis of runoff, *Flood forecasting, *Minnesota, Kawishiwi River Basin.

RIVALL is a deterministic continuous-synthesis, generalized river forecasting program developed by the National Weather Service, River Forecast Center. It normally accepts runoff in inches over the watersheds from ROAPI and ROMELT and uses unit hydrograph procedures to transform the input into daily flows. Using stored data on lakes and reservoirs, it routes through the system and computers both flow and stage at selected points in the system. Both observed or actual flow and computed flow can be printed out in graphical form at the selected locations. RIVALL has been applied to the 1200-square mile Kawishiwi River Basin in North-eastern Minnesota. This Basin is partially located in a national wilderness area, the BWCA (Boundary Waters Canoe Area), and partially in a national forest; it includes two large taconite mines and large deposits of copper-nickel ore. Using runoff data computed by the SSARR model, RIVALL was used to compute runoff rates and route through the system. In general, there was good agreement between observed and computed flows, although gate control changes were difficult to handle on long runs. (Blake-U. MN)
W88-00540

PROCEDURE FOR ESTIMATING FLOW-DURATION CURVES FOR UNGAGED MOUNTAINOUS AND HIGH PLAINS STREAMS IN MONTANA,
Montana State Univ., Bozeman. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-00550

NATIONAL WATER SUMMARY 1985 - HYDROLOGIC EVENTS AND SURFACE-WATER RESOURCES.
Geological Survey, Reston, VA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-198552/AS. Price codes: A22 in paper copy, A01 in microfiche. USGS Water-Supply Paper 2300, 1986. 506 p, 194 fig, 129 tab. Compilers: D. W. Moody, E. B. Chase, and D. A. Aronson.

Descriptors: *National water summary, *Hydrologic events (annual), *Surface water, *Surface water availability, *Water use, *Streamflow, *Rivers, *River basins, Management, Hydrologic maps, Runoff, Rainfall, Water law, Legal aspects, Hydrologic cycles, Water budget, Snow, Ice, Water storage, Water demand, Water yields, Voluntary water transfer, Information transfer, Data collections, Dams, Reservoirs, Hydrologic units.

This summary for 1985 is the third of an annual series by the USGS that describes the conditions, trends, variability, quality, and use of the Nation's water resources. An overview is presented of the distribution, characteristics, uses, and management of the surface-water resources in each of the States and the territories. Each State summary contains multicolor maps showing the location of principal river basins, rivers, reservoirs, hydropower plants, graphs showing average annual discharges and average seasonal variations in precipitation and runoff; and tables presenting streamflow and water-use statistics. Also described are State agencies, laws, and regulations pertaining to surface-water management. In addition to these State descriptions of surface water, individually authored articles describe the role of rainfall and runoff in the hydrologic cycle, generalized water budgets for the 21 water-resources regions, the significance of snow and ice in seasonal storage of water, the effects of dams on surface-water hydrology, the potential for increasing water yields by coordinated management techniques, the voluntary transfers of water in the West, and the improvements in timely communications of information on hydrologic conditions that will enable water managers to more closely match water supply to demand. (USGS)
W88-00556

CONTROL METHOD FOR OPEN CHANNEL,
Hitachi Ltd., Tokyo (Japan).
For primary bibliographic entry see Field 4A.
W88-00591

FLOODS ON VALLEY RIVER, TATHAM CREEK, AND JANALUSKA CREEK IN THE VICINITY OF ANDREWS, NORTH CAROLINA.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-906081. Price codes: A04 in paper copy, A01 in microfiche. Flood Report, TVA/OECD/FPM-82/4, August 1982. 65 p, 3 tab, 9 plates, 4 ref, append.

Descriptors: *Flood forecasting, *Flood plain management, *Prediction, *Management planning, *Flood control, Flood plain zoning, Flood profiles, Flood protection, Floodproofing, Flood damage, Floodwater, Dams, Levees, Flood discharge, Flood hydrographs, Flood plains.

This floodplain information study provides flood data for the Valley River and Tatham and Junaluska Creeks for the town of Andrews, North Carolina to help the town better administer its floodplain management program. Local residents, newspaper articles, reports, and U.S. Geological Survey stream gage records at Tomotla provided data about major flooding back to 1898. Flood discharges and elevations have been computed for the 100- and 500-yr and maximum probable floods. On the Valley River the 100-yr flood would average about 1.5 ft higher than the 1957 flood. The 500-yr flood on the Valley River would average about 2.5 ft higher than the 1957 flood. The maximum probable flood would be approximately 5.5 to 6.5 ft higher than the 1957 flood and 4 to 5 ft higher than the 100-yr flood. The hydraulics of the study area were analyzed using the U.S. Army Corps of Engineers HEC-2B backwater computer program to provide estimates of the 100- and 500-yr and maximum probable flood elevations at selected cross sections. The computed elevations at the cross sections were plotted on a graph at the stream mile locations of the cross sections and joined with straight lines to create flood profiles. Structural solutions to reduce flood damage are dams, levees, and channel modifications. Nonstructural measures include floodplain regulations, flood insurance, floodproofing, flood warning systems, and evacuation plans. (Geiger-PTT)
W88-00645

FIELD EVIDENCE FOR THE FLOW PROPERTIES OF THE TOUTLE VALLEY MUDFLOWS,
Washington Univ., Seattle. Dept. of Geological Sciences.
T. Dunne, J. D. Smith, and M. Wigmosta.
Available from the National Technical Information Service, Springfield, VA 22161, as PB86-157138/AS. Price codes: A08 in paper copy, A01 in microfiche. Final report, May 1983. 146 p, 61 fig, 9 tab, 37 ref. Contract No. 14-34-0001-1413. Project No. Bur Rec C-00233-V.

Descriptors: *Mudflows, *Mt. St. Helens, *Toutle River, *Rheology, *Washington, Yield strength, Bingham viscosity, Debris flows, Discharge measurement, Velocity, Surface velocity.

Field measurements of the average velocity and discharge of the Toutle River debris flows are described and interpreted. Debris flows broke trees in numerous channel locations. The diameters of

snapped trees, along with the diameters and mudline variations on those trees which remained standing, provide quantitative data for determining the rheology of the debris flows. Two channel locations on the upper North Fork of the Toutle River (3 km downstream from the town of St. Helens), and one location, 8 km below the confluence of the North and South Forks of the Toutle River, contained a sufficient number of both broken and standing trees for the flow dynamics to be examined. Vertically averaged velocity of the undisturbed approach flow was determined from the mud marks on the trees by approximating a tree as a circular cylinder and modeling the debris flow as a Bingham material. The diameters of standing trees were used along with the local vertically averaged velocity and total boundary shear stress to calculate a minimum yield strength and a maximum yield strength and minimum viscosity. At various locations groups of standing and broken trees were subjected to nearly identical flow conditions. At these locations the diameters of the smallest standing tree and the largest broken tree were used to bracket the Bingham viscosity and yield strength. By comparing maximum and minimum values at several locations, the spatial distribution of Bingham viscosity and yield strength was determined. The best estimate for the yield strength at the two locations in the upper North Fork is between 0 and 254 N/sq m, with viscosity generally varying between 135 and 477 N-s/sq m. At the site below the confluence the yield strength was between 0 and 180 and the viscosity varied from less than 1 up to 178. (Mohler-USGS)
W88-00651

SURFACE WATER RESOURCES OF SOUTH AFRICA: VOLUME V, DRAINAGE REGIONS MNOQRST, THE EASTERN CAPE, PART 1 (TEXT),
University of the Witwatersrand, Johannesburg (South Africa).
B. J. Middleton, S. A. Lorentz, W. V. Pitman, and D. C. Midgley.
Report No. 12/81, Hydrological Research Unit, January 1982. 167 p, 22 fig, 42 tab, 41 ref, 7 append.

Descriptors: *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Surface water, *Reservoirs, *Rivers, *Meteorological data collections, South Africa, Precipitation, Runoff, Streamflow, Topography, Sediments, Soil types, Water management, Evaporation, Frequency analysis, Water storage, Maps, Land use, Synthetic hydrology, Computer models, Regional analysis, Optimization, Cost analysis, Cost-benefit analysis.

A handbook for hydrologic modeling of surface water resources in the eastern Cape region of South Africa gives background on the model, specific data of the region under study (with maps illustrating topography, geology, soil types, veld types, rainfall and evaporation, distribution of hydrometeorological stations, land use and sediment yield). The manual shows a step-by-step example for the person using a pocket calculator. For example, the reader is shown how to establish the mean annual runoff for the purpose of dimensionalizing the regional diagrams, how to estimate storage requirements, how to generate low flow sequences, how to allow for upstream water use, how to allow for evaporation from storage and accumulation of sediments, and to optimize storage needed for desired draft. For the computer-oriented user, the thru basic models are demonstrated. This permits simulation analysis, which produces time sequences of flow, storage state, spill, shortfall, etc. Cash flow, benefit-cost statistics, and optimization procedures can be obtained. Data tables are published in a separate volume. (See also W88-00660) (Cassar-PTT)
W88-00659

STUDY OF RUNOFF AND EROSION PROCESSES USING LARGE AND SMALL RAINFALL SIMULATORS,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-00714

ALBERTA: SURFACE WATER DATA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
1985. 289 p.

Descriptors: *Hydrologic data collections, *Canada, *Alberta, *Surveys, *Surface water records, *Stream discharge, *Water level, Data collections, Flow measurements, Surface water, Flow discharge, Drainage area, Stream gages.

The results of the hydrometric survey made in Alberta by the Water Survey of Canada for 1984 are presented. For gaging stations where a systematic record of water level or discharge was obtained, a table of daily water level of discharge, a summary of monthly and annual data, and descriptive information is given. Descriptive information provides data on gage type, location, drainage area, contributed data, flow type (natural or regulated), gage datum, and unusual conditions pertaining to the station. Revisions, corrections or additions made to the discharges and water levels after January 1, 1980 are specified. The overall accuracy of the degree of reliability of hydrometric data depends upon gage type and stability, accuracy of observation of stage and measurement of reference datum, the stability of the stage-discharge relationship, or if the control is unstable, the frequency and accuracy of discharge measurements, and the computation procedures and interpretation of records. (Geiger-PTT)
W88-00787

SASKATCHEWAN: SURFACE WATER DATA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
1985. 201 p.

Descriptors: *Stream discharge, *Canada, *Saskatchewan, *Flow discharge, Stream gages, Gages, Streamflow, Flow.

The Water Resources Branch of the Department of the Environment in Canada presents the results of the hydrometric survey investigations which were made in Saskatchewan by the Water Survey of Canada. For gauging stations where a systematic record of water level or discharge was obtained, data are presented for daily water level or discharge, monthly and annual data, and descriptive information on the gauging station (type of gauge, location, drainage area). The overall accuracy or the degree of reliability of hydrometric data presented depends upon the type of gauge, stability of gauge, accuracy of observation of stage and measurement of reference datum; the stability of the stage-discharge relationship; and the computation procedures and interpretation of records. The discharge, or water level, data are presented for each gauging station by alphabetical order. (Halterman-PTT)
W88-00798

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME IV: DRAINAGE REGIONS E, G, H, J, K, L - THE WESTERN CAPE, PART 1 (TEXT),
Hydrological Research Inst., Pretoria (South Africa).
W. V. Pitman, D. J. Potgieter, B. J. Middleton, and D. C. Midgley.
Water Resources Studies, Report No. 13/81, May 1982. 176 p, 23 fig, 49 tab, 41 ref.

Descriptors: *Rainfall-runoff relationships, *Rivers, *Water supply, *South Africa, Irrigation, Land use, Streams, Evaporation, Precipitation, Hydrologic data collections, Maps, Soil types, Meteorological data collection, Surface water, Streamflow, Synthetic hydrology, Flow duration, Frequency analysis, Model studies, Water storage, Evaporation, Sediments, Reservoirs.

Data on the water resources of the Western Cape Region of South Africa. Here all rivers rise in and flow through South African territory. Irrigation farming is highly developed. However, there is sufficient water to irrigate only about 400,000 ha of the more than 500,000 ha of land suitable for irrigation. The major water resources development is the Riviersonderend-Bergrivier-Jonkershoek scheme, of which the key storage is at the 484 million cu m Theewaterskloof dam. Two-thirds of the water in this system is used for irrigation. The Voelvlei project is an off-channel storage fed by canals. The Western Cape Region is characterized by sharp reliefs and canyons. Rainfall is very high in the Hex River mountains and falls off in the valleys and towards the northwest and interior. Evaporation increases from 1300-1400 mm at the coats and 1600 mm in the mountains to 2200-2300 mm in the north. Sediment yields in the Gamka basin and upper Kariega are about 1000 t/sq km/year, among the highest in South Africa; 50-200 t/sq km/year in the remainder of the region. Examples of sample water resource planning problems are given. (Cassar-PTT)
W88-00819

ESTIMATIONS OF STORM RUNOFF AND SEDIMENT YIELD FOR SELECTED SMALL DAM SITES IN KWAZULU,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
R. E. Schulze.
Agricultural Catchments Research Unit, Report No. 12, August 1981. 75 p, 5 fig, 8 tab, 19 ref, 2 append.

Descriptors: *Rainfall-runoff relationships, *Dams, *Runoff, *Sediment yield, *South Africa, KwaZulu, Storm runoff, Hydrologic models, Model studies, Flood peak, Land use, Soil types.

Hydrological simulation models were used to develop information for planning management of 36 earth dams in the Mfuyeni and Biyela wards of KwaZulu. The Soil Conservation Service model, adapted to South African conditions was used to estimate runoff volume and peak discharge rates. The modified Universal Soil Loss Equation was used to estimate sediment yield. Generalized curves for rapid estimations of important hydrological variables were developed. However, they should be used only for examining feasibility of constructing new dams. (Cassar-PTT)
W88-00829

OKLAHOMA'S WATER ATLAS, OKLAHOMA WATER RESOURCES BOARD.
Oklahoma Water Resources Board, Oklahoma City.
For primary bibliographic entry see Field 7C.
W88-00867

ECOLOGICAL CHARACTERIZATION OF THE CENTRAL AND NORTHERN CALIFORNIA COASTAL REGION. VOLUME IV: WATERSHEDS AND BASINS, CHAPTERS 1-16.
Jones and Stokes Associates, Inc., Sacramento, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-155465. Price codes: A99 in paper copy, A01 in microfiche. Report FWS/OBS-80/48.1, October 1981. 690 p, 183 fig, 293 tab. Contract No. 14-16-0009-79-043.

Descriptors: *Rivers, *Wildlife, *Watersheds, *Ecosystems, Geology, Water quality, Fish, Waterfowl, Land use, Economic aspects, Environment, Estuaries, California, River basins, Habitats, Aquatic habitats, Vegetation, Birds.

For central and northern California, land areas are subdivided into 22 watershed units. The following information is given for each watershed: (1) terrestrial, freshwater and estuarine physical-chemical processes and features (includes geology, soils, climate, tsunami hazard, hydrology, and water quality), (2) biological resources (includes information on selected species and areas of ecological concern, preserves, reserves, refuges, conservation areas, sites of known scientific and educational value, anadromous fish spawning areas, wild and scenic rivers, important nesting sites, and waterfowl and shorebird concentration locations), and (3) socioeconomic activities (includes land use, economics, population, and environmental issues). Maps show vegetation and areas of ecological concern. Chapters 1-16, contained in this volume, doc-

ument these watersheds: Smith River, Klamath River, Mad River, Eel River, Mattole River, Noyo River, Gualala River, Russian River, Salmon River, Lagunitas Creek, San Francisco Bay, San Gregorio Creek, San Lorenzo River, and Pajaro River. (See also W88-00901) (Cassar-PTT)
W88-00900

ECOLOGICAL CHARACTERIZATION OF THE CENTRAL AND NORTHERN CALIFORNIA COASTAL REGION. VOLUME IV: WATERSHEDS AND BASINS, CHAPTERS 17-29.
Jones and Stokes Associates, Inc., Sacramento, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-155473. Price codes: A99 in paper copy, A01 in microfiche. Report FWS/OBS-80/48.2, October 1981. 692 p, 302 fig, 128 tab, 499 ref. Contract No. 14-16-0009-79-043.

Descriptors: *Rivers, *Wildlife, *Watersheds, *Ecosystems, *California, Geology, Water quality, Fish, Waterfowl, Land use, Economic aspects, Environment, Estuaries, River basins, Habitats, Aquatic habitats, Vegetation, Birds, Oceanography, Intertidal areas, Tides, Benthos, Coastal waters, Marine environment.

For central and northern California, land areas are subdivided into 22 watershed units. The following information is given for each watershed: (1) terrestrial, freshwater and estuarine physical-chemical processes and features (includes geology, soils, climate, tsunami hazard, hydrology, and water quality), (2) biological resources (includes information on selected species and areas of ecological concern, preserves, reserves, refuges, conservation areas, sites of known scientific and educational value, anadromous fish spawning areas, wild and scenic rivers, important nesting sites, and waterfowl and shorebird concentration locations), and (3) socioeconomic activities (includes land use, economics, population, and environmental issues). Maps show vegetation and areas of ecological concern. Offshore geologic characteristics are used to divide the ocean areas into five basins. For the ocean basins, data on intertidal, pelagic and subtidal benthic physical-chemical processes and features, biological resources, and socioeconomic activities are given. Substrate distribution maps are featured. Areas of biological significance, marine refuges, and ecological preserves are also discussed. Chapters 17-29, contained in this volume, document these watersheds: Elkhorn Slough, Salinas River, Carmel River, Morro Bay, Santa Maria, San Antonio Creek, Santa Ynez, and Point Arguello. The following ocean basins are described: Eel River, Point Arena, Rodega, Santa Cruz, and Santa Maria. (See also W88-00900) (Cassar-PTT)
W88-00901

RUNHYDROGRAPH - THEORY AND APPLICATION FOR FLOOD PREDICTION,
National Inst. for Water Research, Pretoria (South Africa).
L. A. Hiemstra, and D. M. Francis.
Report published by the Water Research Commission, p 1-63, 1979. 9 fig, 10 tab, append, 22 ref.

Descriptors: *Flood forecasting, *Runhydrographs, *Streamflow, Probability distribution, Data processing, Garging, Flood volume, Catchment areas, Statistical analysis, Theoretical analysis, Hydrographs, Flood peak, Timing, Partial-duration floods.

The results of this study allow the extraction of families of hydrographs, composite or otherwise, for any desired return period on any gaged catchment with a homogeneous consistent flood record. It is possible to extend the method to non-homogeneous catchments and to ungauged catchments. The theoretical base for the study is explained, followed by a description of the available database, the most important results which emerged from the data analysis, practical applications, and a sensitivity analysis. All the necessary information for applications is given. (USGS)
W88-00946

SIMULATED STREAMFLOWS IN THE UMFOLOZI CATCHMENT,
Natal Univ., Pietermaritzburg (South Africa).
A. S. Rivett-Carnac, and R. E. Schulze.
Agricultural Catchments Research Unit Report No. 4, p 1-42, 1977. 10 fig, 16 tab, 3 append.

Descriptors: *Catchment areas, *Agricultural watersheds, *Streamflow forecasting, Mathematical models, Hydrologic data, Rainfall rate, Trend surface analysis, Calibration, Planning, Dam sites, Computer programs, Statistical analysis, Dam design, South Africa, Umfolozi.

In order to assess water yield at four possible dam sites, monthly streamflows were simulated. The hydrological flow model used was calibrated on three gaged catchments in the area. The H.R.U.-Monthly Model, modified by the addition of a Trend Surface Analysis for the estimation of catchment rainfall, was selected for this study. Results include estimates of long term average yield, seasonal distribution of flow reliability and probability of occurrence of runoff. (USGS)
W88-00948

SUGGESTED MODIFICATIONS TO THE SCS MODEL FOR IMPROVED ESTIMATIONS OF RUNOFF VOLUME,
Natal Univ., Pietermaritzburg (South Africa).
H. Arnold, and R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 235-252, 1979. 8 fig, 8 tab, 8 ref.

Descriptors: *Storm runoff, *Hydrologic data, *Mathematical models, Model studies, Flood peak, Peak discharge, Peak runoff, Rainfall rate, Infiltration, Water storage, Data processing, Runoff forecasting, Stream gages, Correlation coefficient, Antecedent moisture, Soil water, System analysis, Flood hydrograph.

Chapter 10 of Section C: Hydrological Models and Techniques, investigates the runoff volume component of the SCS model (the United Soil Conservation Service Hydrograph Generating Technique) using South African data. Modifications for improved estimations are suggested. A simple improvement is sought to the Antecedent Precipitation Index (API) which is used to classify a storm into one of the three antecedent moisture classes. (USGS)
W88-00957

2F. Groundwater

HYDROGEOLOGY AND GEOCHEMISTRY OF THE OGALLALA AQUIFER, SOUTHERN HIGH PLAINS,
Texas Univ. at Austin. Bureau of Economic Geology.
R. Nativ, and D. A. Smith.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 217-253, June 15, 1987. 12 fig, 79 ref, append. DOE Contract DE-AC97-83WM46651.

Descriptors: *Ogallala aquifer, *Geohydrology, *Water chemistry, *Aquifers, *Hydrogeology, *Geochemistry, *Chemical composition, Topography, Alluvial deposits, Alluvial fans, Permeability, Groundwater, Isotopes, Saline lakes, Agricultural chemicals, Fertilizers, Industrial wastes, Oil wastes, Water pollution, Groundwater pollution, Water pollution sources.

The Ogallala aquifer, which underlies the Southern High Plains, consists of saturated sediments of the Ogallala Formation (Neogene) that are deposited mainly as a set of humid-type alluvial fans derived from the Rocky Mountains. The Ogallala aquifer, the main source of water for the High Plains of Texas and New Mexico, has been severely depleted by extensive pumpage. The hydrology and geochemistry of the aquifer are controlled by the surface topography of the underlying formations and by the thickness and permeability of the alluvial-fan deposits. Axes of three major alluvial fans trend from northwest to southwest; the fans have increased thickness and permeability compared with interfan areas. Flow lines follow the orientation of the alluvial fans. Along these major axes, the saturated section is thick and the chemical composition is relatively constant. External effects on the chemical composition are less pronounced. The aquifer is thinner and less permeable in areas between major fan axes and along the Caprock Escarpment. In these areas, groundwater can discharge from aquifers in the Cretaceous, Triassic and Permian formations into the Ogallala Formation. Cross-formational movement of water and low permeabilities in the Ogallala Formation result in varying hydrochemical facies and in isotopic compositions that differ from those of the major depositional areas. Areas where upward cross-formational flow occurs are evident by the presence of permeable contacts between the Ogallala and the underlying formations, water-level head differences and chemical and isotope similarities. Secondary factors that locally affect the chemical composition of Ogallala Formation groundwater included contamination from evaporating saline lakes, agricultural chemicals, fertilizers and oil brines. Impact of chemicals and brines may increase in the future because many of these contaminants may still be moving through the unsaturated zone toward the water table. (Author's abstract)
W88-00005

LOCAL EFFECTS OF GROUNDWATER PUMPAGE WITHIN A FAULT-INFLUENCED GROUNDWATER BASIN, ASH MEADOWS, NYE COUNTY, NEVADA, U.S.A.,
Geological Survey, Menlo Park, CA.
S. Rojstaczer.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 319-337, June 15, 1987. 6 fig, 2 tab, 26 ref, append.

Descriptors: *Groundwater pumpage, *Pumpage, *Groundwater recession, *Surface-groundwater relationships, *Groundwater movement, *Groundwater level, *Mathematical models, *Model studies, Data interpretation, Water level, Nevada, Hydraulic systems, Wells, Devils Hole, Ponds, Aquifers, Geologic fractures, Mathematical equations.

Large-scale groundwater pumpage and water-level decline data are used in a preliminary attempt to identify the hydraulic connection between several wells and Devils Hole, a small pond in Nye County, Nevada, U.S.A. Three mathematical models were employed with three different sets of assumptions. Results indicate that despite the discontinuous nature of the local aquifers, many wells have good hydraulic connection with Devils Hole. Hydraulic connection between the wells and Devils Hole exhibits a complex spatial variability typical of carbonate terrain. Zones or directions of minimal hydraulic connection may result from fault-controlled structural discontinuities. Zones or directions of enhanced hydraulic connection point to the presence of large-scale groundwater flow through fractures or conduits. The orientation of water-bearing fractures or conduits inferred from this study is qualitatively consistent with the major orientation of local and regional structural features. (Wood-PTT)
W88-00008

EFFECTS OF BANK STORAGE AND WELL PUMPING ON BASE FLOW, CARMEL RIVER, MONTEREY COUNTY, CALIFORNIA,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W88-00010

EFFECT IF WATER-LEVEL RECOVERIES ON FAULT CREEP, HOUSTON, TEXAS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 4B.
W88-00012

BENEFICIAL ASPECTS OF SEA-WATER INTRUSION,
Scarborough Coll., Westhill (Ontario).
For primary bibliographic entry see Field 4B.
W88-00013

LARGE DATA BASES AND REGIONAL GROUND-WATER QUALITY ASSESSMENTS - AN IOWA CASE STUDY,
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 7C.
W88-00015

ANALYSIS OF HYDRAULIC GRADIENTS ACROSS THE HOST ROCK AT THE PROPOSED TEXAS PANHANDLE NUCLEAR-WASTE REPOSITORY SITE,
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
E. S. Bair.
Ground Water GRWAAP, Vol. 25, No. 4, p 440-447, July-August 1987. 5 fig, 2 tab, 23 ref.

Descriptors: *Hydraulic gradient, *Groundwater movement, *Radioactive waste disposal, *Waste disposal, *Site selection, Fluid mechanics, Radioactive wastes, Texas, Groundwater, Gradients, Specific gravity, Fluid flow, Downflow, Mathematical equations.

Analysis of the direction of groundwater flow across the host rock at the proposed high-level nuclear-waste repository site in Deaf Smith County, Texas, is complicated by vertical and lateral changes in the density of formation fluids in the various hydrogeologic units that overlie and underlie the proposed host rock. Because the concept of hydraulic head is not valid when evaluating vertical hydraulic gradients in a variable-density flow system, other methods were used to determine the direction and magnitude of vertical hydraulic gradients at the proposed site where the specific gravity of formation fluids varies between 1.00 and 1.28. The direction of groundwater flow across the proposed host rock, an 80-foot thick salt bed in the Lower San Andres Formation, was determined by calculating vertical hydraulic gradients based on formation pressure and fluid density data, and by analysis of pressure-depth diagrams. Based on data from the vicinity of the proposed site, both methods indicate the potential for downflow across the host rock. Downflow or predominantly horizontal flow is considered a favorable prewaste emplacement condition because it prolongs the travel time to the biosphere of any naturally or accidentally released radionuclides. (Author's abstract)
W88-00017

STATISTICAL PREDICTION INTERVALS FOR THE EVALUATION OF GROUND-WATER QUALITY,
Illinois State Psychiatric Inst., Chicago.
For primary bibliographic entry see Field 7A.
W88-00019

INTERFACE UPCONING DUE TO A HORIZONTAL WELL IN UNCONFINED AQUIFER,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 4B.
W88-00020

STOCHASTIC IDENTIFICATION OF TRANSMISSIVITY AND EFFECTIVE RECHARGE IN STEADY GROUNDWATER FLOW: 1. THEORY,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
Y. Rubin, and G. Dagan.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1185-1192, July 1987. 2 fig, 13 ref, 2 append.

Descriptors: *Groundwater movement, *Transmissivity, *Effective recharge, *Groundwater recharge, *Recharge, Mathematical equations, Mathematical studies, Aquifers, Model studies, Groundwater.

Previous work identify the values of the log-transmissivity Y for steady flow was continued and extended. The common basic assumptions are that Y is a normal and stationary random space function, the aquifer is unbounded, and a first-order approximation of the flow equation is adopted. The expected value of the water head H, as well as the Y unconditional autocovariance, are supposed to have analytical expressions which depend on a parameters vector Theta. The proposed solution of the inverse problem consists of identifying Theta with the aid of the model and of the measurements of Y and H and subsequently computing the statistical moments of Y conditioned on the same data. The additional features of the present study are : (1) incorporating a constant, but random, effective recharge and its identification and (2) accounting for the fact that Theta estimation is associated with some uncertainty, whereas before Theta was assumed to be identified with certainty. Analytical expressions are derived for the Y and H covariances for an exponential autocovariance of Y. Applications of this method to a real-life case are presented in another paper. (See also W87-12116) (Author's abstract)
W88-00030

STOCHASTIC IDENTIFICATION OF TRANSMISSIVITY AND EFFECTIVE RECHARGE IN STEADY GROUNDWATER FLOW: 2. CASE STUDY,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
Y. Rubin, and G. Dagan.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1193-1200, July 1987. 8 fig, 4 tab, 19 ref.

Descriptors: *Groundwater movement, *Transmissivity, *Effective recharge, *Groundwater recharge, *Recharge, Mathematical equations, Mathematical studies, Aquifers, Avra Valley aquifer, Groundwater, Comparison studies.

A previous published first-order analytical solution of the inverse problem for aquifer steady flow was applied to the Avra Valley aquifer. The parameters characterizing the statistical structure of the log-transmissivity Y and water head H fields were estimated by a maximum likelihood procedure. The results for Y are in good agreement with previous values, in spite of different methods. The incorporation of head measurements has definite advantages in reducing the estimation variances of Y parameters. The best estimates of Y at various points were obtained by simultaneous conditioning on the measurements of Y and H. It is shown that a substantial reduction in the variance of the conditioned Y is achieved by accounting for H measurements, justifying a posteriori the solution of the inverse problem. Finally, the effective recharge, which is assumed to be uniform, but random, is estimated as part of the process. Although the latter is relatively small for Avra Valley, it might be a parameter of considerable interest in other cases. (See also W87-12116) (Author's abstract)
W88-00031

FROM FIELD DATA TO FRACTURE NETWORK MODELING: AN EXAMPLE INCORPORATING SPATIAL STRUCTURE,
Lawrence Berkeley Lab., CA. Earth Sciences Div.
J. C. S. Long, and D. M. Billaux.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1210-1201, July 1987. 11 fig, 7 tab, 24 ref.
DOE Contract DE-AC03-76SF00098.

Descriptors: *Data processing, *Model studies, *Geologic fractures, *Fracture permeability, *Groundwater movement, *Geohydrology, *Fracture network models, Rocks, Field tests, Spatial structures, Geostatistics, Statistics, Mathematical studies, Mathematical equations, Permeability, Fanay-Augeres, France.

A technique for processing field data for a hydrologic fracture-network model accounting for the observed spatial variability generates a network subregion by subregion where the properties of each subregion are predicted through geostatistics. The method was developed for a two-dimensional analysis based on data from Fanay-Augeres, a uranium mine in France. The analysis was extended to three dimensions and compared to the in situ results. The focus is on data collected in a long section of a drift where fractures were mapped and steady state permeability tests were performed in 10 boreholes. In order to generate fractures in a statistically homogeneous region, the region is first divided into statistically homogeneous subregions. In each subregion and for each fracture set, the areal fracture density and the orientation, length and aperture distributions are specified. The fractures are divided into five sets based on tectonic history and it was observed that for each set, fractures spaced closely tend to have similar orientations. This observation is built into the simulation. An estimate of the aperture distribution for each set was made by assuming that the hydraulic apertures of the fractures intersecting a well test zone are proportional to the fracture opening observed in the core. Data input to the geostatistical analysis for each set consisted of 16 values of mean length and density of fractures in each 5 m by 2 m section of the drift wall. The results of the simulation are tables for mean length and fracture density for each of the five sets. The value of density simulated for each region was used directly to determine the number of fractures to be generated in the subregion. The local coefficient of variation for length was the same in every subregion. Using the described data, a 100 m by 100 m fracture network in a series of 100 statistically homogeneous subregions was generated. A 70 m by 70 m region was isolated for directional permeability testing. Results show that the system is barely connected. About 0.1% of the fractures essentially control permeability. (Author's abstract)
W88-00032

ANALYTICAL SOLUTIONS FOR RADIAL DISPERSION WITH CAUCHY BOUNDARY AT INJECTION WELL,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5B.
W88-00033

SIMULTANEOUS CONFIDENCE AND PREDICTION INTERVALS FOR NONLINEAR REGRESSION MODELS WITH APPLICATION TO A GROUNDWATER FLOW MODEL,
Colorado School of Mines, Golden. Dept. of Mathematics.
For primary bibliographic entry see Field 7C.
W88-00035

ANALYSIS AND INTERPRETATION OF BOREHOLE HYDRAULIC TESTS IN DEEP BOREHOLES: PRINCIPLES, MODEL DEVELOPMENT, AND APPLICATIONS,
INTERA Technologies, Inc., Austin, TX.
For primary bibliographic entry see Field 7C.
W88-00045

CARBON-14 DATING OF SOME HOT SPRING WATERS FROM THE EASTERN PYRENEES (SOUTHERN FRANCE) (MESURES DE C-14 DANS QUELQUES EAUX THERMALES DES PYRENEES-ORIENTALES),
Ecole Nationale Superieure de Geologie Appliquee et de Prospection Miniere, Nancy (France).
R. Jaegy, F. Albarede, and G. Michard.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 304, No. 14, p 819-821, April 14 1987. 1 tab, 8 ref.

Descriptors: *Groundwater dating, *Hot springs, *Pyreness, *Carbon radioisotopes, Precipitation, Kaolinite, Minerals, Carbonates, France.

Measurement of carbon-14 in five thermal waters from the Eastern Pyrenees gave an estimated age between 11,500 and 20,000 years B. P. The five waters include: Llo, Les Escaldes, and Saint-Andre at Thues-les-Bains in the valley of Tet, Regina at Carcanieres, and Sainte-Genevieve at Usson in the Aude valley. These waters are alkaline, they contain Na(+) as the dominant cation, and significant amounts of silicates as well. (Airone-PTT)

W88-00049

MODELS FOR THE DISSOLUTION OF CARBONATE ROCKS AND THE C-13/C-12 EVOLUTION OF CARBONATE GROUND WATERS (MODELLE DER KALK-AUFLOESUNG UND C-13/C-12-ENTWICKLUNG VON KARBONAT-GRUNDWAESSERN),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
For primary bibliographic entry see Field 2K.
W88-00068

SUBSURFACE WATER MOVEMENT IN AN UPLAND COASTAL PLAIN SOIL AS INFLUENCED BY PLINTHITE,
Georgia Agricultural Experiment Stations, Athens.
For primary bibliographic entry see Field 2G.
W88-00106

INDIRECT METHOD FOR DETERMINATION OF THE PARAMETERS OF FLOOD PLAIN AQUIFERS,
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
S. Beldring, and L. Gottschalk.
Nordic Hydrology NOHYBB, Vol. 18, No. 2, p 65-78, 1987. 9 fig, 1 tab, 7 ref.

Descriptors: *Surface-groundwater relations, *Alluvial aquifers, *Flood plain aquifers, *Aquifers, *Aquifer characteristics, *Stream-aquifer systems, *Flood plains, Groundwater reservoirs, Rivers, Groundwater level, Piezometric head, Flood waves, Mathematical equations, Storage coefficient, Permeability coefficient, Transmissivity, Gaupne, Norway.

An indirect method of determining flood plain aquifer parameters from estimated autocorrelation of groundwater table data is presented. For this purpose a stream-aquifer system is approximated by a cascade of linear reservoirs. The response of groundwater piezometric head to an arbitrarily varying flood pulse in the river is given by the convolution equations. The autocorrelation function of groundwater piezometric head is expressed as a function of the parameters of the aquifer and the autocorrelation function of the water stage in the river. The ratio between transmissivity and the storage coefficient is determined by comparing empirical and theoretical values of the autocorrelation function of groundwater piezometric height in the stream-aquifer system. Observations from experiments performed in Guapne in western Norway are used to determine the parameters of a flood plain aquifer. (Wood-PTT)
W88-00129

STORAGE COEFFICIENT DETERMINATION FROM QUASI-STEADY STATE FLOW,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
Z. Sen.
Nordic Hydrology NOHYBB, Vol. 18, No. 2, p 101-110, 1987. 5 tab, 16 ref.

Descriptors: *Groundwater storage, *Storage coefficient, *Aquifers, *Confined aquifers, *Wells, *Model studies, Transmissivity, Well data, Groundwater, Mathematical equations, Mathematical models, Model testing, Saudi Arabia.

A method is proposed for determining a unique storage coefficient value for confined and unconfined aquifers tapped by a large diameter well. The prerequisites for the application of this method are estimation of the transmissivity value and the field measurements of well radius, pumping discharge and time-drawdown measurements at large times, or preferably at the steady or quasi-steady state flow conditions. The method was applied to field data obtained and analyzed previously for unconfined and confined aquifers in Saudi Arabia. The application of the method does not require any complicated mathematical procedures or the classical curve matching procedures. It is recommended especially as a supplementary method to the existing techniques in determining the storage coefficient. (Wood-PTT)

W88-00131

DETERMINATION OF STEADY STATE DRAWDOWNS IN A HORIZONTAL DOUBLE AQUIFER SYSTEM: A NEW APPROACH,
Banaras Hindu Univ., Varanasi (India).
V. S. Pandey, S. K. Pandey, and R. N. Pandey.
Nordic Hydrology NOHYBB, Vol. 18, No. 2, p 111-120, 1987. 1 fig, 19 ref, append.

Descriptors: *Groundwater movement, *Drawdown, *Double aquifer systems, *Aquifers, *Mathematical equations, *Data interpretation, Ditkin's operator, Mathematical studies, Pumpage, Evapotranspiration, Groundwater.

Using Ditkin's operator the exact expressions were obtained for drawdowns for a coupled two finite aquifer system in which pumpage from the upper and lower aquifers is balanced by a reduction in evapotranspiration from the upper aquifer. Also, the expressions for drawdowns for the limiting cases (viz. when the horizontal dimension of the aquifers is considered to be infinite) are deduced from one of the general results. It is observed that these results are the same as those obtained previously. The application of Ditkin's operator in obtaining the solution for such problems is new and has not been reported elsewhere in the literature. (Author's abstract)
W88-00132

PLAYA-LAKE BASINS ON THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO: PART I. HYDROLOGIC, GEOMORPHIC, AND GEOLOGICAL EVIDENCE FOR THEIR DEVELOPMENT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2H.
W88-00158

PLAYA-LAKE BASINS ON THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO: PART II. HYDROLOGIC, GEOMORPHIC, AND GEOLOGICAL EVIDENCE FOR THEIR DEVELOPMENT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2H.
W88-00159

GROUND WATER 82: PROGRAMME AND EXTENDED ABSTRACTS.
Geological Society of South Africa, Johannesburg. Ground Water Div.
Conference held July 5-7, 1982, Johannesburg, South Africa, University of the Witwatersrand. 1982. 234 p.

Descriptors: *Groundwater, *Fate of pollutants, *Geohydrology, *Mining industry, Model studies, Aquifers, South Africa, Groundwater management, Recharge, Wells, Boreholes, Infiltration, Water quality, Runoff.

Papers presented before the Geological Society of South Africa, Groundwater Divsion, concern water resource evaluation and management, geohydrological developments and techniques, groundwater pollution, mining (coal, gold, and diamond), and groundwater modeling. Among the individual topics are pumping tests on aquifers (particularly in arid regions), effects of rock on water quality, and water conservation measures such as conjunctive use and wastewater recharge. Models were used to study recharge to aquifers, the effect of stress-related fissure flow into underground mines, and solute transport from a proposed waste disposal site. (See W88-00374 thru W88-00390) (Cassar-PTT)
W88-00388

ANALYSIS OF PUMPING TESTS IN THE GHAAP PLATEAU DOLOMITE, NORTHERN CAPE PROVINCE,
A. S. Harley.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 1-11, 7 fig, 3 ref.

Descriptors: *Groundwater, *Geohydrology, Pumping tests, Aquifer characteristics, Ghaap Plateau, South Africa, Borehole, Dolomite, Geologic fractures, Transmissivity.

Pumping tests were carried out on four fully-penetrating boreholes in a fractured rock, multilayered dolomite aquifer over an area of 0.9 sq km in the Ghaap Plateau, South Africa. Most of the boreholes gave a semiconfined response to pumping to reach equilibrium conditions, probably a result of variations in fracture permeability of the different lithological units in the aquifer. Step-drawdown tests showed that turbulent losses increased significantly at higher discharge rates. This was most likely caused by flow exceeding the critical Reynold's number in both the borehole and adjacent formation. Leakage throughout the aquifer was very variable. An unexplained direct relationship was observed between the leakage factor and the distance from the pupming borehole. A representative transmissivity in the aquifer was 22 cu m/day/m; the storage coefficient, 0.00007. Higher transmissivities were found in localized areas. Results indicate that further testing would show that the aquifer is semiunconfined rather than semiconfined. (See also W88-00373) (Cassar-PTT)
W88-00389

MUNICIPAL WATER SUPPLY FROM JAGERSFONTEIN MINE, ORANGE FREE STATE,
Department of Environmental Affairs, Pretoria (South Africa). Div. of Geohydrology.
T. S. Kok, and B. L. Venter.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 12-25, 5 fig, 2 tab, 5 ref.

Descriptors: *Groundwater, *Geohydrology, *Water supply, *Mines, Jagersfontein, South Africa, Water yield, Groundwater recharge, Recharge.

Groundwater is abstracted from an abandoned diamond mine at Jagersfontein, South Africa, from a depth of 220 m at a rate of 17.5 L/sec. This water supplements the municipal supply, which is insufficient during periods of low rainfall. Annual recharge is about 264,000 cu m. Monthly drawdown of the water level varies from 4 to 66 cm. Water analysis shows that water from the mine shaft is much older than water from a nearby spring and borehole. (See also W88-00373) (Cassar-PTT)
W88-00390

HYDROGEOLOGY OF THE KALAHARI KAROO OF BOTSWANA,
Wellfield Consulting Services, Gaborone (Botswana).
J. L. Farr, and C. Neumann-Redlin.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 32-39, 1 fig.

Descriptors: *Groundwater, *Aquifer characteristics, *Recharge, Groundwater recharge, Kalahari Desert, Karoo, Botswana, South Africa, Geohydrology, Arid lands, Sandstone, Groundwater mining.

The Karoo of Botswana contains two principal aquifer units, The Ecca and the Cave Sandstone. Stormberg lavas have a lower groundwater potential but are important locally. In the Ecca unit hydrogeology is very variable. In general groundwater potential is high and water quality good in the southern margin of the Central Basin in the Letlhakeng area. On the northern and eastern margins potential is moderate to poor with poor water quality. On the northern margins of the Southwest Basin potential may be good, but water quality is variable. On the eastern and southern margins of this basin potential may be good, but water quality is likely to be poor. The highest potential of the Cave Sandstone unit is near the basin margin. Towards the center of the basin, potential and quality are expected to decrease. Recharge occurs only in places where sand cover is less than 6 meters. The absolute amount of recharge in this aquifer system is very small. Therefore, most of the water abstraction in the region must be based

almost entirely on fossil groundwater. (See also W88-00373) (Cassar-PTT)
W88-00392

ISOTOPE HYDROLOGY OF GROUND WATERS OF THE KALAHARI, GORDONIA,
University of the Witwatersrand, Johannesburg (South Africa). Nuclear Physics Research Unit.
B. T. Verhagen.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 117-122, 3 fig.

Descriptors: *Groundwater movement, *Recharge, River beds, Saline water, Isotope studies, Kalahari Desert, Arid lands, Kuruman River, Gordonia, Geohydrology, Water quality.

A hydrological and geophysical survey of fresh water occurrences was conducted in the vicinity of the ephemeral Kuruman River of Gordonia. Radioisotope studies indicated that the waters along the river bed are recent, fresh, and sometimes with measurable tritium. Away from the river the groundwaters have lower tritium contents and highly variable salinities. The riveris not considered an important recharge source for the Kalahari trough area. Here, direct rain recharge predominates. Groundwater in the trough derives some of its salinity during rain recharge. The sources of salinity are incompletely leached evaporite horizons, closed surface basins, and salt loads built up in the unsaturated zone during years of low rainfall. (See also W88-00373) (Cassar-PTT)
W88-00398

DEVELOPED CORRELATION MODEL FOR PREDICTING THE FUTURE DRAWDOWN,
J. Willemink.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 158-164, 2 fig, 4 ref.

Descriptors: *Groundwater movement, *Model studies, Geohydrology, Mathematical models, Mines, Pumping, Water table, Water level, Sishen Mine, South Africa, Recharge.

A model was developed to predict the drawdown of groundwater levels inside the northern section of the Sishen mine, which is separated from the southern section by an impermeable dyke. This model is usable when 10,000 to 20,000 cu m/day of water is removed from the mine. The model can be used to calculate the drawdown for several pumping rates. Integrating a particular pumping rate over a period between a certain date and the time on which the groundwater level has reached a defined critical level gives the total groundwater volume which can be abstracted. (See also W88-00373) (Cassar-PTT)
W88-00400

HYDROLOGICAL DISTURBANCES ASSOCIATED WITH INCREASED UNDERGROUND EXTRACTION OF COAL,
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
For primary bibliographic entry see Field 5B.
W88-00402

CONSTRUCTION OF A FINITE DIFFERENCE MODEL OF THE ATLANTIS AQUIFER AND A DISCUSSION OF PRELIMINARY RESULTS,
Department of Environmental Affairs, Pretoria (South Africa). Div. of Geohydrology.
D. B. Bredenkamp.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 192-204, 6 fig, 2 tab, 1 ref.

Descriptors: *Groundwater, *Water supply, Aquifer characteristics, Model studies, Atlantis Aquifer, Coastal aquifers, Pumping tests, Mathematical models, Recharge, Groundwater recharge.

A finite difference model was used to assess the performance of the Atlantis coastal sand aquifer under conditions of severe pumping and subnormal recharge. Three groundwater units were identified: Silwerstroom (drained by the spring), Springfontuyn (draining to the sea), and Wesfleur (draining to the Zoute River). In the simulation at average recharge and abstraction from a spring and eight borholes, a steady state emerged after 73 years. However, drawdown was increased at some nodes. With average abstraction and no recharge from rainfall, one of the nodes would go dry within 4.3 years; several others would not maintain full capacity. If only the spring were pumped during a period of no recharge, pumping could continue for 6.4 years. (See also W88-00373) (Cassar-PTT)
W88-00403

EVALUATION OF STRESS RELATED FISSURE FLOW INTO UNDERGROUND WORKINGS USING FINITE ELEMENTS,
G. S. Esterhuizen, and J. A. C. Diering.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 217-223, 4 fig, 3 ref.

Descriptors: *Groundwater movement, *Seepage, *Mining industry, Gold mines, Model studies, Mathematical models, Finite element methods, Stress analysis, Hydraulic conductivity, South Africa, Fissure water, Conductivity.

A finite element method for modeling stress effects on fissure flow in two dimensions is described. The mode is applied to the example of seepage through jointed rock at a depth of 800 meters in a gold mine. Some seepage was occurring through a dyke separating flooded, abandoned workings from the dry workings. A plan proposing to seal off remaining connections between the wet and dry sections was evaluated with the model. Model results showed that this plan would significantly decrease the water flow in the disused workings. (See also W88-00373) (Cassar-PTT)
W88-00404

SECOND INTERNATIONAL CONFERENCE ON GROUND WATER QUALITY RESEARCH, PROCEEDINGS.
Oklahoma State Univ., Stillwater. Univ. Center for Water Research.
For primary bibliographic entry see Field 5B.
W88-00534

ESTIMATION OF VERTICAL HYDRAULIC CONDUCTIVITY OF THE CLAY LAYER BETWEEN THE EUTAW AND GORDO AQUIFERS IN THE VICINITY OF FAUNSDALE, MARENGO COUNTY, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
M. Planert, and A. K. Sparkes.
Available from USGS, OFSS, Box 25425, Denver CO 80225. USGS Water Resources Investigations Report 85-4083, 1985. 23 p, 19 fig, 1 tab, 4 ref.

Descriptors: *Groundwater, *Confined aquifers, *Confining beds, *Hydraulic conductivity, *Clays, *Alabama, Aquicludes, Groundwater movement, Groundwater management, Groundwater availability, Marengo County.

The vertical hydraulic conductivity of the confining bed between the Gordo and Eutaw aquifers in the vicinity of Faunsdale, in northeast Marengo County, Alabama, is 0.00001 foot per day or less. Modeling vertical conductivities larger than 0.00050 foot per day produced drawdowns in the Eutaw aquifer greater than those observed in a test where 750 gallons per minute were pumped from the Gordo aquifer. Modeling has shown that vertical hydraulic conductivity of the confining bed is the controlling factor on the drawdown in the Eutaw aquifer. At equilibrium (steady-state) pumping 750 gallons per minute there was 3 feet of drawdown in the Eutaw aquifer with a confining bed conductivity of 0.00001 foot per day. When the conductivity was decreased to 0.000001 foot per day, drawdown in the Eutaw aquifer was only 0.35 foot. A conductivity of 0.00001 foot per day in the 48-hour simulation reproduced the drawdown in the well from the 48-hour pumping test, but the conductivity may be as small as an untested 0.000001 foot per day. (USGS)
W88-00558

STATISTICAL CHARACTERIZATION AND NUMERICAL SIMULATION OF A FRACTURE SYSTEM -- APPLICATION TO GROUNDWATER FLOW IN THE STRIPA GRANITE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
A. Rouleau.
Ph. D. Thesis, 1984. 416 p, 73 fig, 23 tab, 103 ref, 10 append.

Descriptors: *Sweden, *Fractures (geologic), *Fracture geometry, *Stochastic processes, Porosity, Rock mass, Fluid velocity, Simulation, Monte Carlo method, Stripa.

The geometry of the fracture system must be incorporated in the hydrogeological study of a fractured rock mass, particularly if flow porosity and fluid velocity are parameters of interest. A method of analysis is presented that integrates the statistical characterization of fracture geometry (fracture orientation, size, spacing and density) and the stochastic discrete fracture simulation of groundwater flow through fracture networks. The methodology developed was applied to a granite rock mass at Stripa, Sweden. Four fracture sets were defined for the rock mass surrounding the Ventilation drift at Stripa, on the basis of fracture orientation data obtained from drill cores and fracture maps. For each fracture set the distributions of trace lengths and spacings were analyzed and an average value of fracture density (L-1) was computed. A number of sampling bias, including orientation bias, trace length censoring and trace length truncation, were considered in the statistical analysis, and appreciable differences were found between fracture sets for fracture densities as well as for trace length distributions. The stochastic discrete fracture numerical model developed for this study used a Monte Carlo method and field fracture and hydrology data to simulate groundwater flow in two-dimensional sections containing the Ventilation drift at Stripa. A number of synthetic networks of randomly located fractures were generated, using distributed orientations, lengths and apertures for each fracture set. The steady-state fluid flow parameters were computed for each generated network using boundary conditions determined from field hydraulic pressure measurements. The mean value of fracture aperture was progressively adjusted from one network realization to the other in order to match as closely as possible the total water flow measured during the macropermeability experiment. These simulations yielded estimates of mean fracture aperture that were comparable to those calculated from field injection tests. The modelling exercises also provided valuable insight into the effective fracture porosity and the fluid velocity, two determining factors for the transport properties of a fractured rock. (USGS)
W88-00560

METHOD FOR CONSTRUCTING A SCREEN THAT OBSTRUCTS THE FLOW OF SUBSOIL WATER,
Stevin Construction Inc., Dover, DE.
For primary bibliographic entry see Field 4B.
W88-00583

UNDERGROUND LEACHATE BARRIER AND METHOD OF MAKING SAME,
For primary bibliographic entry see Field 5G.
W88-00585

GROUNDWATER PROTECTION SYSTEM,
Environmental Design, Inc., Palm Beach, FL.
For primary bibliographic entry see Field 5G.
W88-00615

REVIEW OF GROUND-WATER FLOW AND TRANSPORT MODELS IN THE UNSATURATED ZONE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-00656

GEOSTATISTICAL MODELING OF PORE VELOCITY,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-00675

STREAM-AQUIFER INTERACTION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2A.
W88-00743

GEOHYDROLOGICAL ASPECTS OF THE VRYBURG COMPARTMENT: THE DEVELOPMENT AND EVALUATION OF TECHNIQUES FOR THE DETERMINATION OF THE GROUND-WATER POTENTIAL IN THE SOUTHERN ORANGE FREE STATE AND NORTHERN CAPE PROVINCE; VOLUME 4,
Water Research Commission, Pretoria (South Africa).
C. Van der Westhuizen, and F. D. I. Hodgson.
December, 1981. 287 p, 168 fig, 47 tab, 2 plates, 53 ref, 2 append.

Descriptors: *Geohydrology, *South Africa, *Aquifers, *Water supply development, *Geophysics, *Groundwater potential, Groundwater, Water quality, Water demand, Water supply, Borehole geophysics, Groundwater recharge, Aerial photography, Satellite technology, Models, Hydrologic models, Remote sensing, Infrared imagery.

This document describes an investigation into the groundwater occurrences and resources in the Vryburg Area. The investigation included geological and geohydrological mapping, detailed geophysical surveys, thermal infrared scanning, drilling and aquifer testing, hydrochemical analysis and subsurface modelling with the aim of ultimately augmenting the existing commonage water supply to meet the current and future water demand. Several target areas could be identified where future groundwater development would be feasible. These areas are all situated to the west of the Vryburg Township, in the area underlain by the permeable Vryburg Quartzite. This formation has the best water yielding properties and the best water quality properties. The aquifer is replenished mostly during the wet season by a single year of above average rainfall, at the present rate of abstraction. The methods of remote sensing used during the study (LANDSAT imagery, aerial photography, infrared thermal scanning, air-borne magnetic surveys and visual inspection by low flying aircraft) all proved valuable in specific ways. Geophysical techniques employed during the study included magnetic, electrical resistivity and down-the-hole surveys. The conjunctive use of groundwater from all the aquifers surrounding Vryburg, and the numerical modelling of the groundwater system in this particular area are recommended as areas of further study. (Geiger-PTT)
W88-00793

OKLAHOMA'S WATER ATLAS, OKLAHOMA WATER RESOURCES BOARD.
Oklahoma Water Resources Board, Oklahoma City.
For primary bibliographic entry see Field 7C.
W88-00867

SUPPLEMENTAL GROUNDWATER SUPPLIES FOR SIX SMALL COMMUNITIES IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W88-00870

GEOLOGY FOR ENVIRONMENTAL PLANNING IN STARKE COUNTY, INDIANA,
Indiana State Dept. of Natural Resources, Indianapolis.
For primary bibliographic entry see Field 5G.
W88-00871

DATA COLLECTION AND MATHEMATICAL MODELING FOR PREDICTING UNDERGROUND MINE WATER INFLOW, VOLUME I,
Williams-Robinette and Associates, Inc., Viola, ID.
R. Williams, G. Bloomsburg, G. Winter, and D. Ralston.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-171108. Price codes: A15 in paper copy, A01 in microfiche. BuMines OFR 26(1)-83, August 1982. 327 p, 109 fig, 12 tab, 159 ref, 6 append. Contract No. J0100013.

Descriptors: *Groundwater, *Groundwater movement, Infiltration, Seepage, Percolating water, Model studies, Computer models, Hydraulic models, Hydrologic models, Mine water, Data collections, Hydrologic data collections, Data interpretation.

The hydrologic variables associated with surface water and underground systems that affect the inflow of groundwater into an underground mine, are evaluated in a study of underground mine water inflow initiated by the U.S. Bureau of Mines. Data collection methodologies, including several innovative techniques, are reviewed for their applicability for quantifying these hydrologic variables. Existing analytical and numerical procedures for predicting underground mine water inflow, including over 300 computer models, are reviewed and evaluated. The model UNSAT2 is utilized for modeling inflow to shaft and tunnel, or drift. This model and the techniques developed in this study are applied to two existing mines. (Halterman-PTT)
W88-00897

SPECIAL GROUNDWATER STUDY OF THE MIDDLE DELAWARE RIVER BASIN, STUDY AREA, VOLUME I, (CHAPTERS 1-7),
Wright (R.E.) Associates, Middletown, PA.
For primary bibliographic entry see Field 2A.
W88-00921

SPECIAL GROUNDWATER STUDY OF THE UPPER DELAWARE RIVER BASIN, STUDY AREA II, VOLUME II, (CHAPTERS 8-11),
Delaware River Basin Commission, Trenton, NJ.
R. E. Wright.
(1983). 151 p, 24 fig, 31 tab, 7 append. Prepared for the Delaware River Basin Commission.

Descriptors: *Delaware River Basin, *Interstate rivers, *Aquifers, *Geologic units, *Land use, *Groundwater pollution, *Geohydrology, *Groundwater hydrology, *Mineralogy, River basins, Carbonates, Carbonate rocks, Groundwater depletion, Hydrologic aspects, Watersheds, Contamination.

This volume continues the study of the Upper Delaware River Basin begun in Volume I. To describe groundwater quality in the Middle Delaware River Basin, tabulations were made of inventoried background, or natural water quality in order to identify those aquifers which contain groundwater which may not be of suitable quality for use in either domestic, agricultural or industrial applications. It was found that mineralogy of hydrogeologic units is generally reflected by the chemical quality of the associated groundwater. In the carbonate rocks, the high dissolution rate and resulting high carbonate concentration in some cases reduces the utility of this groundwater as an industrial source. More than 80% of all documented groundwater contamination was found to involve organic chemicals. Ten areas in the study area exhibited degraded groundwater quality, and three others were found to be relatively free of recorded incidents of groundwater contamination. The present total reported rate of groundwater withdrawals in the study area is approximately 233.4 mg/d. There are 362 reported groundwater users who pump more than 10,000 gallons/day. Of these 50% are industrial and commercial users, 43% are water purveyors, and 7% are other types of users. To establish land use patterns, data from several agencies which inventory land use were compiled to develop a land use map for the study area for 1970, and this map was overlaid by a 1980 map made with an enhanced LANDSAT image. It was found that nearly 50% of the area is covered by forests. However, future growth is anticipated around existing urban centers. (See also W88-00921, W88-00923, W88-00924) (Hawkins-Omniplan)
W88-00922

SPECIAL GROUNDWATER STUDY OF THE UPPER DELAWARE RIVER BASIN, STUDY AREA III, VOLUME I,
Wright (R.E.) Associates, Middletown, PA.
N. Wehler.
(1983). Prepared for the Delaware River Basin Commission. 168 p, 40 fig, 19 tab, 4 append.

Descriptors: *Delaware River Basin, *Surface-groundwater relations, *Overdraft, *Flow augmentation, *Industrial water use, *Contamination, *Interstate rivers, River basins, River mechanics, Water use, Competing use, Well regulations, Storage, Water storage.

Due to the size of the Delaware River Basin, and the different cultural, hydrogeologic, and physiographic provinces within it, this study was divided into three separate regional investigations. This report is concerned with the upper reaches of the Delaware River Basin which lie within the Appalachian Ridge and Valley and Plateau Provinces. In general, the groundwater of the Basin was found to be quite good, and well within the drinking water standards established by EPA. Exceptions to this are related to man-made contaminants introduced into the system. Nine simplified stratigraphic units were identified as having potential ground water quality problems. Water usage by New York City far exceeds the total average water use of all other users combined within Study Area III. However, there are other large users of both surface and groundwater supplies. Significant surface withdrawals by public supplies and industrial users occur along the Delaware, Schuylkill and Lehigh Rivers, and peak seasonal usage of water supplies can be relatively large in some areas. It is recommended that suitable sites for streamflow augmentation should have a large volume of estimated available storage, adequate saturated thickness for wellfield production, a dissociation from main branches of the Delaware River, be located above reservoirs, and have low present use of groundwater and surface water. Seven wellfield management options are also listed. (See also W88-00921, W88-00922, W88-00924) (Hawkins-Omniplan)
W88-00923

SPECIAL GROUNDWATER STUDY OF THE MIDDLE DELAWARE RIVER BASIN, STUDY AREA II, VOLUME III, (CHAPTERS 12-14),
Wright (R.E.) Associates, Middletown, PA.
For primary bibliographic entry see Field 4B.
W88-00924

OCCURRENCE AND QUALITY OF GROUND WATER IN THE VICINITY OF BROWNSVILLE, TEXAS,
Texas Dept. of Water Resources, Austin.
R. D. Preston.
Report 279, September 1983. 99 p, 13 fig, 5 tab, 84 ref.

Descriptors: *Water quality, *Texas, *Groundwater availability, *Water supply, Stratigraphy, Aquifer characteristics, Hydrologic cycle, Groundwater recharge, Groundwater movement, Water use, Irrigation water, Industrial water, Domestic water, Chemical properties, Well data, Water supply development.

The City of Brownsville, Texas in 1972 requested technical and financial assistance from the Texas Water Development Board (now Texas Department of Water Resources) in regard to water-supply possibilities. In order for the Board to provide financial assistance, an evaluation of all possible water-supply sources was needed. This report is a description of the evaluation of the availability and quality of ground water in the city, or approximately 150 sq miles. Information was collected on

168 existing wells, and 21 test holes were drilled. Some 179 water samples were collected for chemical analysis. All data indicate three distinct producing zones within the area, with only the deep zone (150 to 225 ft or 46 to 69 m) capable of producing significant amounts of usable quality water. Generally, quality within this zone deteriorates gradually from < 1,000 mg/L dissolved solids about 12 miles west of Brownsville > to 10,000 mg/L within the eastern part of the city. At least 350,000 acre-ft of fresh to slightly saline water is calculated to be in storage within this deep zone in the study area. Water-quality maps indicated three areas that are feasible for development of additional groundwater. Computer simulations of pumpage within these areas indicate that the development of > 10 million gallons/day with < 2,000 mg/L dissolved solids is possible. (Author's abstract)
W88-00930

OCCURRENCE, QUALITY AND AVAILABILITY OF GROUND WATER IN CALLAHAN COUNTY, TEXAS,
Texas Dept. of Water Resources, Austin.
R. D. Price, L. E. Walker, and T. W. Sieh.
Report 278, August 1983. 157 p, 25 fig, 10 tab, 76 ref.

Descriptors: *Groundwater availability, *Texas, *Water quality, *Aquifers, *Well data, Brine disposal, Geologic history, Stratigraphy, Hydrologic cycle, Groundwater recharge, Water level fluctuations, Aquifer characteristics, Water use, Domestic water, Irrigation water, Industrial water, Water supply development, Groundwater pollution.

This study identified the sources of water in Callahan County, Texas suitable for domestic, livestock, public supply, and irrigation uses. To further evaluate the future effects of irrigation of municipal pumpage from the Antlers aquifer, a network of observation wells should be established in Callahan County to record the water levels annually. An inventory was made of all municipal, industrial, and irrigation wells, all springs, and a representative inventory of domestic and livestock wells. Water levels were measured where possible, and well data were gathered. The principal source of fresh to very saline groundwater in Callahan County is the Antlers Formation of the Trinity Group of Cretaceous age. Chemical quality of the groundwater varies widely. Dissolved-solids concentrations in ground water from the Antlers ranges from 134 to 16,923 mg/L. About 1,900 acre-ft of groundwater, or approximately 1.7 million gallons/day, was used within the county for all purposes during 1978. Recharge to the Antlers Formation, derived from precipitation on its outcrop, is estimated at 5,400 acre-ft/yr, representing 1.5% of the county's average annual rainfall that reaches the water table and enters storage. One-half of the total annual effective recharge, or about 2,700 acre-ft, can probably be safely developed from the aquifer yearly. (Fazio-Omniplan)
W88-00932

OCCURRENCE, AVAILABILITY, AND QUALITY OF GROUND WATER IN TRAVIS COUNTY, TEXAS,
Texas Dept. of Water Resources, Austin.
G. Brune, and G. L. Duffin.
Report 276, June 1983. 231 p, 30 fig, 7 tab, 65 ref.

Descriptors: *Groundwater availability, *Texas, *Water quality, *Aquifers, *Well data, *Structural geology, *Groundwater potential, Stratigraphy, Hydrologic cycle, Groundwater recharge, Aquifer characteristics, Water level fluctuations, Water quality, Mineralization, Salinity, Water use, Drinking water, Domestic water, Irrigation water, Groundwater pollution, Water supply development.

This groundwater investigation was carried out from January 1966 through April 1979 to determine and evaluate the groundwater resources of Travis County, Texas. It is recommended that, to determine long-term changes in water levels and seasonal variations, additional observation wells be located in areas not now covered, especially where there has been a rapid rate of decline in the potentiometric surface. A network of water-quality observation wells also is needed. An inventory was made of existing water wells used for municipal, industrial and irrigation purposes and of representative domestic and livestock wells. Information on selected oil wells, test holes, and springs was obtained as well as on large abandoned or destroyed wells. Geologic and hydrologic units which yield fresh to moderately saline groundwater in Travis County, in order of their importance as aquifers are: the Edwards and associated limestones, the Trinity Group, the alluvium and terrace deposits, the Austin chalk, the Navarro and Taylor Groups, igneous rocks around Pilot Knob, and the Midway Group. Permeability in the Edwards is high and water moves rapidly through it. Well yields are often very large, however, the aquifer is susceptible to pollution via open sink holes where recharge occurs. The total average annual recharge was estimated to be slightly less than 40,000 acre-ft. (Fazio-Omniplan)
W88-00933

GROUND-WATER AVAILABILITY OF THE LOWER CRETACEOUS FORMATIONS IN THE HILL COUNTRY OF SOUTH-CENTRAL TEXAS,
Texas Dept. of Water Resources, Austin.
J. B. Ashworth.
Report 273, January 1983. 173 p, 30 fig, 26 tab, 61 ref.

Descriptors: *Groundwater availability, *Texas, *Well data, *Aquifers, *Aquifer characteristics, *Water quality, Topography, Catchment areas, Surface drainage, Aquifers, Geologic history, Stratigraphy, Structural geology, Deposition, Geologic formation, Water use, Groundwater recharge, Groundwater level, Well yield, Drilling, Water conservation, Aquifer testing.

This study describes the hydrologic characteristics of the Trinity Group aquifer in Texas, essentially the only groundwater source for all but the extreme northern portion of the study region. It is divided, in ascending order, into the lower, middle, and upper aquifer units. Hydrologic data were gathered from December 1974 to October 1978 primarily from high capacity wells, including public supply, industrial, and irrigation wells. Also an attempt was made to inventory all perennial springs. The lower Trinity aquifer, which includes the Hosston Sand and Sligo Limestone Members of the Travis Peak Formation, yields small to large quantities of groundwater. The middle Trinity aquifer is the most widely used of the three. It yields small to moderate quantities of fresh to slightly saline water. Yields of the upper aquifer are generally very small due to the low porosity and permeablity of the Glen Rose Limestone, and the chemical quality is normally poor because of the presence of evaporite beds. Chemical quality of water in the Trinity Group is variable. Water acceptable for human consumption, although very hard, is available over most of the region. Poor water quality is usually due to excessive concentrations of sulfate and chloride. High concentration of iron, nitrate, and flouride are also common problems. Although approximately 200,000 acre-ft of annual rainfall is estimated to be available as recharge, much of it is lost by natural rejection via small springs, seeps, and evapotransperation. (Fazio-Omniplan)
W88-00934

OCCURRENCE, AVAILABILITY, AND CHEMICAL QUALITY OF GROUND WATER IN THE CRETACEOUS AQUIFERS OF NORTH CENTRAL TEXAS,
Texas Dept. of Water Resources, Austin.
P. L. Nordstrom.
Report 269, Vol. 1, April 1982. 109 p, 39 fig, 14 tab, 70 ref. Vol. 2, July 1982. 387 p, 20 fig, 80 tab.

Descriptors: *Groundwater availability, *Texas, *Aquifers, *Water quality, *Groundwater depletion, Geologic history, Stratigraphy, Structural geology, Water use, Municipal water, Domestic water, Livestock, Industrial water, Groundwater potential, Water supply development, Pumping tests, Irrigation water.

The general purpose of this study was to determine the groundwater resources of the Cretaceous aquifers in north-central Texas, with emphasis on the water used for municipal, industrial, and irrigation purposes from the Woodbine and Trinity Groups. Data were also included on minor aquifers being used in the study region. The Trinity Group is the largest and most prolific aquifer in the study area's 15,500 sq miles. Chemical quality in this aquifer updip from the fresh to slightly saline water limit is suitable for most public supply and industrial uses. Yields of wells completed in the aquifer increase in a downdip direction with wells producing up to 1,900 gal/min. Water-level declines have been recorded in the Trinity Group since the first part of the 20th century. Total pumpage for public supply, industry, and irrigation from the Antlers, Twin Mountains, and Paluxy Formations in 1976 was, respectively, 8,870 acre-ft, 38,600 acre-ft, and 10,000 acre-ft. Yields of wells completed in the Woodbine averaged 160 gal/min with measured quantities of as much as 1,170 gal/min. Chemical quality deteriorates rapidly in well depths below 1,500 ft (457 m). In areas between the outcrop and this depth, quality is very good overall as long as ground water from the upper Woodbine is sealed off. Volume 1 of this report contains interpretive information in text and related figures and tables. Volume 2 contains supporting basic data including well location maps, records of wells, water-level measurements, chemical analyses of water, and drillers' logs. (Fazio-Omniplan)
W88-00935

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN HEMPHILL COUNTY, TEXAS: PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,
Texas Dept. of Water Resources, Austin.
A. E. Bell, and S. Morrison.
Report 267, February 1982. 64 p, 24 fig, 18 tab, 76 ref.

Descriptors: *Texas, *Aquifers, *Aquifer characteristics, *Water storage, *Projections, *Ogalla aquifer, *Groundwater mining, *Water yield, Computers, Pumpage, Pumping, Well yield, Structural geology, Groundwater storage, Water level, Water users, Water supply, Water shortage, Water conservation.

This study resulted from a need to illustrate to the High Plains water users in Hemphill County, Texas that the groundwater supply is being depleted. This study was also conducted to provide information to local, State, and federal officials for implementing plans to alleviate the water shortage problem. Livestock production and area agribusinesses are heavily dependent on groundwater resources. The Ogallala aquifer in Hemphill County contained approximately 12.4 million acre-ft (15.3 cu km) in 1974. Historical pumpage has exceeded 20,000 acre-ft (0.02 cu km) annually, which is approximately one and one-half times the rate of natural recharge to the aquifer in the county. This overdraft is expected to continue, ultimately resulting in reduced well yields, reduced acreage irrigated, and reduced agricultural production. Groundwater in the county is unevenly distributed. Some areas have ample resources to support current usage through the year 2020; in other areas, groundwater is in short supply. To obtain maximum benefits from the remaining groundwater resources, Hemphill County water users should implement all possible conservation measures so that the remaining groundwater supply is used prudently. The Texas Department of Water Resources used computers to conduct evaluation and projection studies of groundwater resources. The report was prepared using only data readily available in the Department's files. Information for 1974 is considered reliable; projections of future conditions should be used only as a guide. (Fazio-Omniplan)
W88-00936

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN LIPSCOMBE COUNTY, TEXAS:

PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, AND WELL YIELDS,
Texas Dept. of Water Resources, Austin.
A. E. Bell, and S. Morrison.
Report 262, February 1981. 64 p, 24 fig, 18 tab, 76 ref.

Descriptors: *Texas, *Water yield, *Groundwater mining, *Ogallala aquifer, *Aquifers, *Aquifer characteristics, *Water storage, *Projections, Computers, Pumpage, Pumping, Well yield, Structural geology, Groundwater storage, Water level, Water users, Water supply, Water shortage, Water conservation.

This study was undertaken to illustrate to the High Plains water users in Lipscombe County, Texas that the groundwater supply is being depleted. The study was also conducted to provide information to local, State, and federal officials for implementing plans to alleviate the water shortage problem. Agricultural use of groundwater is high and the water used by rural residents, municipalities and local industries is also mostly from groundwater supplies. The Ogallala aquifer in Lipscomb County contained approximately 15.9 million acre-ft (19.6 cu km) in 1974. Historical pumpage has exceeded 35,000 acre-ft (0.04 cu km) annually, which is approximately one and one-half times the rate of natural recharge to the aquifer in the county. This overdraft is expected to continue, ultimately resulting in reduced well yields, reduced acreage irrigated, and reduced agricultural production. Groundwater in the county is unevenly distributed. Some areas, have ample resources to support current usage through the year 2020; in other areas groundwater is in short supply. To obtain maximum benefits from the remaining groundwater resources, Lipscomb County water users should implement all possible conservation measures so that the remaining groundwater supply is used prudently. The Texas Department of Water Resources used computers to conduct evaluation and projection studies of groundwater resources. The report was prepared using only data readily available in the Department's files. Information for 1974 is considered reliable; projections of future conditions should be used only as a guide. (Fazio-Omniplan)
W88-00937

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN WHEELER COUNTY TEXAS: PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,
Texas Dept. of Water Resources, Austin.
A. E. Bell, and S. Morrison.
Report 266, February 1982. 64 p, 24 fig, 18 tab, 76 ref.

Descriptors: *Aquifers, *Texas, *Ogallala aquifer, *Groundwater mining, *Water yield, *Aquifer characteristics, *Water storage, *Projections, Computers, Pumpage, Pumping, Well yield, Structural geology, Groundwater storage, Water level, Water users, Water supply, Water shortage, Water conservation.

This study resulted from a need to illustrate to the High Plains water users in Wheeler County, Texas that the groundwater supply is being depleted. The study was also conducted to provide information to local, State, and federal officials for implementing plans to alleviate the water shortage problem. Wheeler County provides a total farm income of over $28 million annually, thus groundwater supplies are critical to its' economy. The Ogalla aquifer in Wheeler County contained approximately 1.6 million acre-ft (2.0 cu km) in 1974. Historical pumpage has exceeded 35,000 acre ft (0.04 cu km) annually, which is approximately one and one-half times the rate of natural recharge to the aquifer in the county. This overdraft is expected to continue, ultimately resulting in reduced well yields, reduced acreage irrigated, and reduced agricultural production. Groundwater in the county is unevenly distributed. Some areas have ample resources to support current usage through the year 2020; in other areas, groundwater is in short supply. To obtain maximum benefits from the remaining ground water resources, Wheeler County water users should implement all possible conservation measures so that the remaining ground water supply is used prudently. The Texas Department of Water Resources used computers to conduct evaluation and projection studies of ground-water resources. The report was prepared using only data readily available in the Department's files. Information for 1974 is considered reliable; projections of future conditions should be used only as a guide. (Fazio-Omniplan)
W88-00938

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN POTTER AND OLDHAM COUNTIES TEXAS: PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,
Texas Dept. of Water Resources, Austin.
A. E. Bell, and S. Morrison.
Report 265, January 1982. 71 p, 24 fig, 18 tab, 76 ref.

Descriptors: *Aquifers, *Texas, *Water yield, *Ogalla aquifer, *Groundwater mining, *Aquifer characteristics, *Water storage, *Projections, Computers, Pumpage, Pumping, Well yield, Structural geology, Groundwater storage, Water level, Water users, Water supply, Water shortage, Water conservation.

This study is intended to illustrate to the High Plains water users in Potter and Oldham Counties, Texas, that the groundwater supply is being depleted. The principal source of fresh groundwater in the area is the Ogallala aquifer. The study was also conducted to provide information to local, State, and federal officials for implementing plans to alleviate the water shortage problem. The Ogallala aquifer in Potter and Oldham Counties contained approximately 2.1 million acre-ft (2.6 cu km) of water in 1974. Historical pumpage has exceeded 50,000 acre-ft (0.06 cu km) annually, which is approximately twice the rate of natural recharge to the aquifer in the counties. This overdraft is expected to continue, ultimately resulting in reduced well yields, reduced acreage irrigated, and reduced agricultural production. Groundwater in the counties is unevenly distributed. Some areas have ample resources to support current usage through the year 2020; in other areas, groundwater is in short supply. To obtain maximum benefits from the remaining groundwater resources, water users should implement all possible conservation measures so that the remaining groundwater supply is used prudently. The Texas Department of Water Resources used computers to conduct evaluation and projection studies of ground water resources. The report was prepared using only data readily available in the Department's files. Information for 1974 is considered reliable; projections of future conditions should be used only as a guide. (Fazio-Omniplan)
W88-00939

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN HARTLEY COUNTY, TEXAS: PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,
Texas Dept. of Water Resources, Austin.
A. E. Bell, and S. Morrison.
Report 261, January 1981. 64 p, 24 fig, 18 tab, 76 ref.

Descriptors: *Aquifers, *Texas, *Ogallala aquifer, *Water yield, *Groundwater mining, *Aquifer characteristics, *Water storage, *Projections, Computers, Pumpage, Pumping, Well yield, Structural geology, Groundwater storage, Water level, Water users, Water supply, Water shortage, Water conservation.

This study resulted from a need to illustrate to the High Plains water users in Hartley County, Texas that the groundwater supply is being depleted. The study was also conducted to provide information to local, State, and federal officials for implementing plans to alleviate the water shortage problem. Groundwater is important to the county's economy because most crops are irrigated with groundwater. The Ogallala aquifer in Hartley County contained approximately 25.4 million acre-ft (31.3 cu km) of water in 1974. Historical pumpage has exceeded 175,000 acre-ft annually, which is approximately five times the rate of natural recharge to the aquifer in the county. This overdraft is expected to continue, ultimately resulting in reduced well yields, reduced acreage irrigated, and reduced agricultural production. Groundwater in the county is unevenly distributed. Some areas have ample groundwater resources to support current usage through the year 2020; in other areas, groundwater is in short supply. To obtain maximum benefits from the remaining groundwater resources, Hartley County water users should implement all possible conservation measures so that the remaining groundwater supply is used prudently. The Texas Department of Water Resources used computers to conduct evaluation and projection studies of groundwater resources. The report was prepared using only data readily available in the Department's files. Information for 1974 is considered reliable; projections of future conditions should be used only as a guide. (Fazio-Omniplan)
W88-00940

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN DONLEY COUNTY TEXAS: PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,
A. E. Bell, and S. Morrison.
Report 260, January 1981. 64 p, 24 fig, 18 tab, 76 ref.

Descriptors: *Aquifers, *Water yield, *Groundwater mining, *Ogallala aquifer, *Texas, *Aquifer characteristics, Water storage, Projections, Computers, Pumpage, Pumping, Well yield, Structural geology, Groundwater storage, Water level, Water users, Water supply, Water shortage, Water conservation.

This study resulted from a need to illustrate to the High Plains water users in Donley County, Texas that the groundwater supply is being depleted. The study was also conducted to provide information to local, State, and federal officials for implementing plans to alleviate the water shortage in the High Plains. The Ogallala aquifer in Donley County contained approximately 3.1 million acre-ft (3.8 cu km) of water in 1974. Historical pumpage has exceeded 25,000 acre-ft (0.03 cu km) annually, which is approximately two times the rate of natural recharge to the aquifer. This overdraft is expected to continue, ultimately resulting in reduced well yields, reduced acreage irrigated, and reduced agricultural production. Groundwater in the county is unevenly distributed. Some areas have ample groundwater resources to support current usage through the year 2020; in other areas of the county, groundwater is currently in short supply. To obtain maximum benefits from the remaining groundwater resources, Donley County water users should implement all possible conservation measures so that the remaining groundwater supply is used in the most prudent manner. The Texas Department of Water Resources used computers to conduct evaluation and projection studies of groundwater resources. The report was prepared using only data readily available in the Department's files. Information for 1974 is considered reliable; projections of future conditions should be used only as a guide. (Fazio-Omniplan)
W88-00941

ISOTOPIC, CHEMICAL AND DISSOLVED GAS CONCENTRATIONS IN GROUNDWATER NEAR BEAUFORT WEST,
National Physical Research Lab., Pretoria (South Africa).
J. C. Vogel, A. S. Talma, and T. H. Heaton.
CSR Research Report No 392, p 1-34, 1980. 13 fig, 7 tab, 23 ref.

Descriptors: *Groundwater, *Isotope studies, *Radioisotopes, *Geohydrology, Boreholes, Sampling, Water analysis, Carbon, Oxygen isotopes, Nitrogen, Stable isotopes, Cations, Anions, Dissolved oxygen, Groundwater recharge, Tritium, Helium, Argon, Radon, Uranium, South Africa, Beaufort West.

Groundwater was collected from fifteen boreholes over an area of 500 sq km to the north-east of Beaufort West, Cape Province, South Africa. Six boreholes were sampled at different depths using a pump equipped with inflatable packers. Samples were analyzed for their carbon-14, tritium, oxygen-18, carbon-13, helium, nitrogen, argon, oxygen, and radon-222 contents, uranium-234/uranium-238 activity ratios, and major ion chemistry. The study was a reconnaissance survey, but demonstrated the usefulness of multi-parameter investigations. The data are used in discussing the geohydrology of the area with emphasis on the recharge sources of groundwater in the pediment and at the foot of the surrounding escarpment. (USGS)
W88-00947

2G. Water In Soils

RELATIONSHIPS BETWEEN WATER INFILTRATION AND OIL SPILL MIGRATION IN SANDY SOILS,
Coastal and Marine Engineering Research Inst., Haifa (Israel). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-00003

PARAMETER ESTIMATION FOR UNSATURATED FLOW AND TRANSPORT MODELS - A REVIEW,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. B. Kool, J. C. Parker, and M. T. Van Genuchten.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 255-293, June 15, 1987. 6 fig, 6 tab, 77 ref.

Descriptors: *Model studies, *Parameter estimation, *Unsaturated flow, *Soil water movement, *Vadose water, *Estimation techniques, *Data interpretation, Solute transport, Aeration zone, Groundwater, Reviews, Hydraulic properties, Mathematical equations, Flow discharge.

The current status of parameter estimation techniques and their utility for determining key parameters affecting water flow and solute transport in the unsaturated (vadose) zone are reviewed. Historically, hydraulic and transport properties of the unsaturated zone have been determined by imposing rather restrictive initial and boundary conditions so that the governing flow and transport equations can be inverted by analytical or semi-analytical methods. Contrary to these direct methods, parameter estimation techniques do not impose any constraints on the model, on the stipulation of initial and boundary conditions, on the constitutive relationships, or on the treatment of inhomogeneities via deterministic or stochastic representations. While parameter estimation analyses of subsurface saturated flow are increasingly common, their application to unsaturated flow and transport processes is a relatively new endeavor. Nevertheless, a number of laboratory and field applications currently exist that show the great potential of parameter estimation techniques for improved designs and analyses of vadose zone flow and transport experiments. Several practical examples for determining unsaturated soil hydraulic functions and various transport parameters are presented, and advantages and limitations of the estimation process are discussed. Specific research areas in need of future investigation are outlined. (Author's abstract)
W88-00006

FLOWS FROM A CLAY SOIL - SEASONAL CHANGES AND THE EFFECT OF MOLE DRAINAGE,
Institute of Hydrology, Wallingford (England).
M. Robinson, J. Mulqueen, and W. Burke.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 339-350, June 15, 1987. 6 fig, 1 tab, 20 ref.

Descriptors: *Clays, *Surface flow, *Mole drainage, *Seasonal variation, *Drainage effects, *Drainage, *Soil management, Grasslands, Rainfall, Surface runoff, Flow, Storm runoff, Drainage practices, Drainage patterns.

Six years' data were collected from a sloping grassland site with a clay soil. The high rainfall, together with a shallow topsoil on a much more impermeable soil, led to frequent surface saturation and a rapid storm response. A third of the annual rainfall was discharged in the surface 10 cm thick root layer of the topsoil. With artificial drainage by mole drains, surface layer flow was almost completely eliminated and, in winter and early spring, peak drain flows were less than surface flows from undrained land. However, the reverse was the case in the autumn when, following the opening up of shrinkage cracks in summer, there was rapid flow generation to the mole drains resulting in much higher discharges that those from the undrained site. This pattern was observed in each of the five years after drainage and was applicable for a wide range of storm sizes and intensities. Such seasonal behavior is probably much more widespread than is generally realized. (Author's abstract)
W88-00009

EFFECT OF SOIL WATER HYSTERESIS ON SOLUTE MOVEMENT DURING INTERMITTENT LEACHING,
University of New England, Armidale (Australia). Dept. of Resource Engineering.
For primary bibliographic entry see Field 5B.
W88-00036

THEORETICAL STUDY OF THE ESTIMATION OF THE CORRELATION SCALE IN SPATIALLY VARIABLE FIELDS: 1. STATIONARY FIELDS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 7C.
W88-00037

KINEMATIC WAVE APPROXIMATION TO THE TRANSPORT OF ESCHERICHIA COLI IN THE VADOSE ZONE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Soils and Crops.
For primary bibliographic entry see Field 5B.
W88-00039

WATER MOVEMENT IN A FINITE LAYER: ABSORPTION FOR CONSTANT WATER CONTENT AT THE SURFACES,
Hochschule der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Mathematik.
U. Hornung, J.-Y. Parlange, W. L. Hogarth, L. D. Connell, and R. Peters.
Soil Science Society of America Journal SSJD4, Vol. 51, No. 3, p 557-562, May-June 1987. 2 fig, 2 tab, 21 ref, 1 append. ARGS Grant F8161771.

Descriptors: *Soil water, *Soil surfaces, *Water movement, *Water absorption, *Soil, *Numerical analysis, *Diffusivity, *Layered soils, Mathematical studies, Soil wetting front, Soil interface, Flow, Analytical approximation, Soil water potential.

The accurate, analytical formulation presented describes very simply the outflow of water from a soil layer when the potentials (water contents) are maintained constant at both surfaces. The analytical formulation is adapted from a previously developed approach to the present problem. The accuracy of the results were checked by comparison with a precise numerical simulation which is greatly simplified for a Brooks and Corey type diffusivity. It is suggested that a laboratory experiment using this configuration would yield the soil properties relevant for adsorption. (Author's abstract)
W88-00103

COPPER ACTIVITY IN SOIL SOLUTION: I. MEASUREMENT BY ION-SELECTIVE ELECTRODE AND DONNAN DIALYSIS,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5A.
W88-00104

SUBSURFACE WATER MOVEMENT IN AN UPLAND COASTAL PLAIN SOIL AS INFLUENCED BY PLINTHITE,
Georgia Agricultural Experiment Stations, Athens.
L. J. Blume, H. F. Perkins, and R. K. Hubbard.
Soil Science Society of America Journal SSJD4, Vol. 51, No. 3, p 774-779, May-June 1987. 2 fig, 3 tab, 21 ref.

Descriptors: *Water movement, *Soil water, *Groundwater, *Plinthite soil horizon, *Soils, *Subsurface water, *Subsurface water flow, Bromide, Precipitation, Perched, Tifton loamy sand, Piezometers, Evapotranspiration, Saturated conductivity, Groundwater, Water table.

Water movement in a Tifton loamy sand (Plinthic Paleudult) was monitored using bromide as a tracer for 86 weeks under natural rainfall conditions following treatment in late summer. Potassium bromide was placed at depths between 10 and 43 cm and 60 and 102 cm in a soil with 4.4% slope. Bromide content of water from piezometers at distances up to 60 m down slope was determined at 2- to 4-week intervals during periods of perched water starting 22 weeks after injection date. Determinations were then made for a 65-week period. Soil samples taken at depths to 4.72 m 1 yr after treatment were analyzed for bromide content. A perched or secondary water table occurred during periods of high rainfall and low evapotranspiration. Data indicate that subsurface flow down slope occurred primarily above and within the plinthic horizon during periods when a perched water table was present. Data from soil samples collected 1 yr after KBr treatment indicate that bromide moved slowly through the plinthic layer, was intercepted by subsurface layers of high density, and was retained in the watershed until removed by lateral flow. (Author's abstract)
W88-00106

RAINSTORM RELATED TERRAIN FAILURES IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W88-00545

USING SATURATED HYDRAULIC CONDUCTIVITIES TO ASSESS THE INTERACTION BETWEEN SALINE/SODIC IRRIGATION WATERS AND SOUTH DAKOTA SOILS,
South Dakota State Univ., Brookings. Water Resources Inst.
For primary bibliographic entry see Field 3C.
W88-00548

DIGRD: AN INTERACTIVE GRID GENERATING PROGRAM,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7C.
W88-00657

PREDICTING CHEMICAL MOVEMENT IN SOILS,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5B.
W88-00719

PROCESS FOR STRENGTHENING SOFT SOIL,
Chiyoda Chemical Engineering and Construction Co. (Japan).
For primary bibliographic entry see Field 8D.
W88-00764

FIELD METHODS FOR DETERMINING THE WATER HOLDING CAPACITY OF SOIL (VELDMETODE VIR DIE BEPALING VAN WATERHOUVERMOE VAN GROND),
Citrus and Subtropical Fruit Resources Inst., Nelspruit (South Africa).
G. S. Bredell, C. F. Human, and P. J. Muller.
Citrus and Subtropical Fruit Journal (Houghton), No 602, p 6-9, 1980. 6 tab, 1 ref.

Descriptors: *Soil moisture potential, *Soil properties, Field tests, Soil analysis, Soil texture, Soil moisture retention, Wetting, Clays, Soil water potential, Irrigation.

Four different wetting areas of a field method (equivalent to 25 mm irrigation) were evaluated on three types of soil and the wetting depths and water contents determined. The results were checked against laboratory tests using a pressure membrane extractor and a porous plate apparatus. The use of a soil auger was discarded in favor of direct measurement of wetting depth. The water content at field capacity may be comparatively accurately determined by wetting an area of 0.25 square meters with 12.5 liters of water (equivalent to 50 mm irrigation), measuring the wetting depths of sandy and loamy soils after 24 hours and clayey soils after 48 hours. It was found that 40 percent and 33 percent of the water content at field capacity gave a comparatively reliable indication of the readily available water in sand and loamy sand respectively. (USGS)
W88-00949

SOILS,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 41-55, 1979. 2 fig, 5 tab, 14 ref.

Descriptors: *Soil surveys, *Mapping, *Soil classification, *Soil profiles, Soil properties, Soil types, Topsoil, Subsoil, Field capacity, Soil water.

In Chapter 3 of Section A: The Cedara Catchments - General Background, an attempt is made to classify soils of the Cedara Catchments into recognizable and identifiable units using soil forms and phases as mapping units. The results discussed have practical application in lumped and distributive simulation modeling of water yield and flood volumes/peaks. As the need arises, it may be necessary for laboratory tests on hydrologically relevant properties to be undertaken at more sites because present results display a high degree of variability of those variables used in estimations of water holding capacities of soils. (USGS)
W88-00952

CATCHMENT SOIL MOISTURE DISTRIBUTION AT CEDARA,
Natal Univ., Pietermaritzburg (South Africa).
A. S. Hope, and R. E. Schulze.
University of Natal Agricultural Catchments Research Unit Report No 7, Part 1 - Field Studies, Data Processing, Techniques and Models for Applied Hydrological Research - Vol 1, p 275-297, 1979. 6 fig, 3 tab, 9 ref.

Descriptors: *Soilwater, *Spatial distribution, *Soil moisture meters, Resistance, Gypsum, Calibrations, Experimental data, Subsurface water, Water storage, Topography, Vegetation effects, Electrical equipment.

Chapter 12 of Section C: Hydrological Models and Techniques, outlines the preparation, calibration and limitations of gypsum electrical resistance blocks, followed by a description and presentation of results of a soil moisture experiment at Cedara, conducted with gypsum electrical resistance blocks. Soil moisture storage is a function of topography. The soil moisture regime of a neutral slope or spur is different from that of a valley or watercourse. North- and south-facing slopes have different soil moisture regimes. The distribution of soil moisture, both temporally and vertically, differs between forest and grassland. (USGS)
W88-00959

2H. Lakes

ECOLOGY OF HUMIC AND NON-HUMIC DUNE LAKES, FRASER ISLAND, WITH EMPHASIS ON THE EFFECTS OF SAND INFILLING IN LAKE WABBY,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
A. H. Arthington, H. B. Burton, R. W. Williams, and P. M. Outridge.
Australian Journal Marine Freshwater Research AJMFA4, Vol. 37, No. 6, p 743-764, 1986. 9 fig, 12 tab, 26 ref.

Descriptors: *Lakes, *Zooplankton, *Limnology, *Ecology, *Australia, Humic lakes, Non-humic lakes, Dune lakes, Invertebrates, Lake Wabby, Littoral environment, Lake morphometry, Perched lakes.

Aspects of physicochemical limnology and the zooplankton, littoral invertebrates and fish of dune lakes on Fraser Island, Australia, are described and compared. The comparisons highlight differences between perched, humic lakes and non-humic Lake Wabby, a water-table window with some morphometric and biological features typical of dune barrage lakes. Lake Wabby has been partially infilled by a mobile sand dune moving mainly in a northwesterly direction across the northern end of the lake. The maximum rate of dune advance estimated from aerial photos was 5.03 m/year, between 1948 and 1958. Sand infilling between 1975 and 1984 altered the morphometry and substrate characteristics of the lake's eastern region and reduced maximum depth from 13.0 to 11.5 m and volume by 43 percent. The number of benthic invertebrates was reduced from 14 taxa in 1975 to six taxa in 1984; there was also a significant decrease in abundance of benthic Chironomini during this period (ANOVA, P less than 0.05). In both years, an undescribed species of Conochironomus was the most abundant benthic invertebrate in Lake Wabby (250-700 individuals/m2). A new genus of Chironomini (near Paralauter borniella) was discovered. Lake Wabby supported 11 species of fish in 1975 and 1984, but the perched lakes had only one or two species. The five most abundant species in Lake Wabby in 1975 showed evidence of partitioning of food resources, of which the main components were benthic invertebrates and filamentous algae. Allochthonous food resources were not important in fish diets. The possible long-term effects of sand infilling on food resources, fish diets and the composition of the zooplankton in Lake Wabby require further work extended over all seasons and several years. (Master-PTT)
W88-00002

SIMPLE RECURSIVE FORMULA TO REPLACE WILSON'S GRAPHICAL LAKE ROUTING,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7C.
W88-00011

DISTRIBUTION AND COMMUNITY STRUCTURE OF THE BENTHIC FAUNA OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE DESCRIBED BY NUMERICAL METHODS OF CLASSIFICATION AND ORDINATION,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
B. Long, and J. B. Lewis.
Marine Biology MBIOAJ, Vol. 95, No. 1, p 93-101, June 1987. 7 fig, 6 tab, 32 ref.

Descriptors: *Estuaries, *Limnology, *Macroinvertebrates, *Statistical methods, *Gulf of Saint Lawrence, *Spatial distribution, *Aquatic populations, Invertebrates, Species diversity, Numerical analysis, Population density, Temperature effects, Sediments, Water depth.

The invertebrate benthic macrofauna of the northern part of the Gulf of St. Lawrence was sampled with a van Veen grab along a series of transects from 37 to 285 m in May, 1981. The pattern of spatial distribution was determined by classification and ordination techniques and by diversity and evenness statistics. Classification and ordination resulted in eleven station groups which could be divided into three broad faunal zones related to temperature, depth, and sediment composition. The proportions of suspension feeders increased with sand content and non-selective deposit feeders increased with mud content. Faunal diversity increased with depth. The results of this study have largely corroborated some previous findings on diversity patterns and depth zonation in the Gulf. The use of family abundance data for broad characterization of distribution and community structure in the Gulf thus appears justified. (Author's abstract)
W88-00047

ELEMENTARY CHEMICAL COMPOSITION (C, H, N) AND ENERGY EQUIVALENT OF ACARTIA CLAUSI (CRUSTACEA: COPEPODA), AN IMPORTANT SPECIES IN THE BIOENERGETICS OF THE COASTAL ECOSYSTEMS OF THE NORTHWEST MEDITERRANEAN (COMPOSITION CHIMIQUE ELEMENTAIRE (C, H, N) ET EQUIVALENT ENERGIE D'ACARTIA CLAUSI (CRUSTACEA: COPEPODA), ESPECE IMPORTANTE DANS LA BIOENERGETIQUE DES ECOSYSTEMES COTIERS DE MEDITERRANEE NORD-OCCIDENTALE),
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 5C.
W88-00048

SIMULATION OF SALTMARSH WATER COLUMN DYNAMICS,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 2L.
W88-00058

CLIMATIC AND TECTONIC EFFECTS ON SEDIMENTATION IN A RIFT-VALLEY LAKE: EVIDENCE FROM HIGH-RESOLUTION SEISMIC PROFILES, LAKE TURKANA, KENYA,
Duke Univ., Beaufort, NC. Marine Lab.
For primary bibliographic entry see Field 2J.
W88-00110

COMPARATIVE STUDY OF WATER LEVEL REGIMES AND LITTORAL BENTHIC COMMUNITIES IN SCOTTISH LOCHS,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
B. D. Smith, P. S. Maitland, and S. M. Pennock.
Biological Conservation, Vol. 39, No. 4, p 291-316, April 1987. 13 fig, 2 tab, 41 ref.

Descriptors: *Littoral environment, *Scotland, *Limnology, *Reservoirs, *Pumped storage, *Water level fluctuations, Zooplankton, *Conservation, Benthos, Benthic fauna, Ecosystems, Water level fluctuations, Fluctuations, Reservoirs, Invertebrates.

There has been little research on the impact of fluctuating water levels on the littoral communities of Scottish lochs. In 1980, 27 lochs were visited and the physical characteristics, macrophytes and zoobenthos of selected shores were studied. Long-term water level data were available for most of the lochs and these were used to divide them in to three categories with (1) natural, (2) minor (i.e. less than 5m fluctuation in the year preceding sampling), and (3) major fluctuations (i.e. more than 5m fluctuation in the year preceding sampling). Examples of the weekly variations in water level changes over a year are given. The biological results were relatively clear. Though most of the shores studied had comparable substrates, the flora and fauna were linked with the type of water regime of the previous years. In the natural lochs and those with minor fluctuations in level, the littoral macrophytes and zoobenthos were usually varied and reasonably abundant, but in the lochs

with major fluctuations the flora and fauna were very impoverished and sometimes completely absent. Ways of ameliorating this impoverishment in new reservoirs include engineering the eventual littoral zone so that slope and erosion are similar to those prevailing in natural systems and using artificial mats of plants which would provide cover and moisture for invertebrates during periods of drawdown. (Master-PTT)
W88-00113

USE OF TIDAL FRESHWATER MARSHES BY FISHES AND MACROFAUNAL CRUSTACEANS ALONG A MARSH STREAM-ORDER GRADIENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
L. P. Rozas, and W. E. Odum.
Estuaries ESTUDO, Vol. 10, No. 1, p 36-43, March 1987. 3 fig, 2 tab, 37 ref, append. US Department of Commerce Grant No. NA81AA-D-00025.

Descriptors: *Tidal Marshes, *Freshwater marshes, *Fish, *Crustaceans, Marshes, Stream order, Stream gradient, Shrimp, Killifish, Silverside, Crabs, Fish populations, Aquatic plants, Submerged plants, Tidewater.

Fishes and invertebrate macrofauna (nekton) were sampled biweekly (July through October 1985) from the surface of tidal freshwater marshes. Samples were collected with flume nets at three different stream orders (orders 2, 3, and 4+) along a marsh stream order gradient. Twenty-five species of fishes (5,610 individuals, 17.072 kg preserved wet weight) representing 13 families, and three species of invertebrates (19,570 individuals, 13.026 kg preserved wet weight) were collected. The most abundant species were the grass shrimp (Palaemonetes pugio), mummichogs (Fundulus heteroclitus), banded killifish (F. diaphanus), inland silversides (Menidia beryllina), and blue crabs (Callinectes sapidus). Invertebrate catches (mostly grass shrimp and blue crabs) were not significantly different among stations. Total numbers of fishes were significantly greater at both headwater (order 2) and main creek (order 3) stations than river (order 4+) stations, but catches of headwater and main creek stations were not significantly different. The relationship between marsh stream order and fish abundance may partly be related to the distribution of submerged aquatic vegetation (SAV) within marsh tidal creeks. SAV decreases in abundance with increasing stream order. Some species may use SAV as a refuge from predators or as a foraging area during low tide when the marsh surface is inaccessible. The presence of SAV in tidal creeks may enhance the habitat value of adjacent marshes. (Author's abstract)
W88-00137

PLAYA-LAKE BASINS ON THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO: PART I. HYDROLOGIC, GEOMORPHIC, AND GEOLOGICAL EVIDENCE FOR THEIR DEVELOPMENT,
Geological Survey, Reston, VA.
W. R. Osterkamp, and W. W. Wood.
Geological Society of American Bulletin BUCMA, Vol. 99, No. 2 , p 215-223, August 1987. 11 fig, 3 tab, 52 ref.

Descriptors: *Texas, *New Mexico, *Playas, *Lake formation, Rainfall, Infiltration, Carbonates, Percolation, Solute transport, Recharge, Groundwater recharge, High Plains aquifer, Aquifers.

The occurrence of playas, a large number of transient lakes, in the Southern High Plains of Texas and New Mexico was examined. The formation of these lakes are initiated by a variety of processes. The expansion of playa basins is largely a hydrological process that results from ponding of precipitation, infiltration, and downward transport of solutes and particulates and organic material by percolating groundwater. Oxidation of organic material in the unsaturated zone creats conditions that perpetuate the carbonate-dissolution process. Removal of lithologic carbonates and downward movement of clastic material by infiltration or piping during ground-water recharge events increase sub-surface voids to a degree that subsidence of near-surface beds underlying playa floors may occur. Evidence suggests that recharge to the High Plains Aquifer is principally from plays lakes. (See also W87-12419) (Ray-PTT)
W88-00158

PLAYA-LAKE BASINS ON THE SOUTHERN HIGH PLAINS OF TEXAS AND NEW MEXICO: PART II. HYDROLOGIC, GEOMORPHIC, AND GEOLOGICAL EVIDENCE FOR THEIR DEVELOPMENT,
Geological Survey, Reston, VA.
W. W. Wood, and W. R. Osterkamp.
Geological Society of American Bulletin BUCMA, Vol 99, No. 2 , p 224-230, August 1987. 1 fig, 2 tab, 25 ref.

Descriptors: *New Mexico, *Playas, *Texas, *Groundwater recharge, Subsidence, Organic matter, Infiltration, Carbonates, Silicates.

Hydrologic, geomorphic, geologic, and mass-balance evidence supports the hypothesis of transient-lake formation in the Southern High Plains of Texas and New Mexico. These lakes develop mainly by micropiping and solution rather than by eolian processes. A key element in this analysis is the observation that carbon dioxide concentration increases below the soil zone; therefore, infiltrating water is thermodynamically subsaturated with respect to carbonate and silicate minerals, causing (1) dissolution of carbonates and silicates throughout the unsaturated zone and not confined to the soil zone, (2) transport of clastic and organic particulate matter into the subsurface, and (3) increases in void space by evaluation and piping. Water ponded in playa basins concentrates particulate organic material that moves downward into the unsaturated zone during recharge events. Oxidation of the organic matter in the unsaturated zone forms carbonic acid and causes continuing carbonate dissolution at depth, which increases secondary porosity and results in subsidence and subsequent expansion of the playa depression. Because lacustrine deposits in a playa lake floor becomes less permeable with increasing thickness, recharge flux is increased in the abbular area surrounding the playa floor. Location of recharge at the periphery of the lake floor increases solution and piping in the area, resulting in outward growth of the basin through time. Playa expansion may cease if the floor area, relative catchment area, becomes too great to maintain water depths sufficient to cause recharge around playa-floor perimeter. (See also W87-12418) (Ray-PTT)
W88-00159

AQUATIC COLEOPTERA AND HEMIPTERA IN SOME CANADIAN SALINE LAKES: PATTERNS IN COMMUNITY STRUCTURE,
British Columbia Univ., Vancouver. Dept. of Zoology.
J. Lancaster, and G. G. E. Scudder.
Canadian Journal of Zoology CJZOAG, Vol 65 No. 6, p 1383-1390, June 1987. 6 fig, 2 tab, 40 ref, append. NSERC scholarship and NSERC operating grant.

Descriptors: *Limnology, *Aquatic insects, *Salinity effects, *Saline lakes, *Aquatic organisms, *Physiochemistry, *Community structure, *British Columbia, Canada, Species diversity, Population density, Insects.

Twenty-eight coleopteran and 8 hemiptern species were studied in eight fishless lakes of varying salinities in central British Columbia. Species were characteristic of high, moderate, or low salinities, or species tolerant of all salinities. Although species distributions were disjunct at conductivities of 80 and 5000 micro Siemens/cm, community complexity changed more gradually with salinity. Densities increased and species richness, species diversity, feeding guild diversity, and ecological category diversity decreased with increased conductivity. Predatory Coleoptera were well represented in all lakes, but herbivores were less abundant with increased salinity. A curious size-distribution pattern was observed: a wide range of species sizes occurred in the most freshwater lake, but fewer size classes and only small sizes were represented in more saline lakes. (Author's abstract)
W88-00162

PUBLICATIONS OF THE WATER RESEARCH INSTITUTE.
National Board of Waters, Helsinki (Finland). Water Research Inst.
1984. 48 p.

Descriptors: *Limnology, *Lakes, *Kinetics, *Zooplankton, *Bioassays, *Hydrobiology, Heterotrophic bacteria, Aquatic environment, Plankton, Dinoflagellates, Primary productivity, Microbiological studies.

The series of methodological articles on the measurement of aquatic heterotrophic activity, originates from several independent studies of Finnish lakes and coastal areas, carried out during 1978-1982. Most of these studies were financed by the National Board of Waters with water protection funds, and were carried out in the Water districts of Vaasa, Tampere, Helsinki, Kokkola, and Kainuu. The series covers the following topics: measurement of heterotrophic activity in the aquatic environment using labelled substrates, linear transformations of the Michaelis-Menten kinetic equation in natural microbial communities research, heterotrophic glucose uptake potential of three marine dinoflagellates, determination of the Michaelis-Menten kinetic parameters with single concentration assays, practical approach to the measurement of microbial heterotrophic activity by the single concentration method, and variability in planktonic heterotrophic activity and primary productivity assays in relation to sampling strategies. This series is a sequel to 'Communications of the Hydrological Office,' 'Soil and Hydrotechnical Office,' and 'Soil and Hydrotechnical Investigations.' (See also W88-00208) (Geiger-PTT)
W88-00230

MEASUREMENT OF HETEROTROPHIC ACTIVITY IN THE AQUATIC ENVIRONMENT USING LABELLED SUBSTRATES,
Tvarminne Zoological Station (Finland).
T. Tamminen, and J. Kuparinen.
IN: Publications of the Water Research Institute, National Board of Waters, Helsinki, 1984. p 4-10, 87 ref.

Descriptors: *Limnology, *Lakes, *Hydrobiology, *Heterotrophic bacteria, *Monitoring, *Multivariate analysis, Food chain, Aquatic environment, Ecosystems, Models, Microbiological studies, Statistical analysis, Bioassays.

One approach to evaluate the trophic role of microbial heterotrophic organisms in the food web of aquatic ecosystems is to measure the assimilation of radioactively-labelled substrates. The single concentration method of measuring either the turnover time or maximal uptake velocity has been developed to study heterotrophic activity in a shorter amount of time. As a monitoring parameter, heterotrophic activity measurements have revealed trends in the heterotrophy of a water body and changes in heterotrophy-autotrophy relations. In statistical multivariate analyses of ecological data, heterotrophic activity parameters have been used to describe the functional role of microheterotrophy in the ecosystem. When quantifying the flows of energy and carbon through the pelagic food web, the flow from autotrophs to the dissolved organic carbon (DOC) pool has received increasing attention. Results support the use of a single model substrate (glucose) as an indicator of this rapidly cycling fraction DOC. In ecotoxicological studies, heterotrophic activity measurements can be applied to screening tests. Monitoring of the heterotrophic processes in Finnish lakes and coastal brackish waters have been continuously emphasized. Some studies have utilized the single concentration assay for screening-type toxicity testing. Other research has studied the role of heterotrophic microorganisms in the structure and function of the ecosystem. (See also W88-00208) (Geiger-PTT)

W88-00231

LINEAR TRANSFORMATIONS OF THE MICHAELIS-MENTEN KINETIC EQUATION IN NATURAL MICROBIAL COMMUNITIES RESEARCH,
Tvarminne Zoological Station (Finland).
T. Tamminen.
IN: Publications of the Water Research Institute, National Board of Waters, Helsinki, 1984. p 11-19, 9 fig, 1 tab, 17 ref, append.

Descriptors: *Limnology, *Kinetics, *Microbiological studies, *Hydrobiology, *Substrates, Theoretical analysis, Population dynamics, Mathematical equations, Mathematical studies, Heterotrophic bacteria, Regression analysis.

The Michaelis-Menten kinetic formula has been widely utilized in ecological studies for describing the active transport of substrates into microbial cells. Since the original formula is in hyperbolic form, several linear transformations have been presented to generate kinetic parameters in laboratory studies of microbial cultures. In aquatic ecological research with natural populations or communities, the so-called Lineweaver-Burk transformation has almost solely been used. In this paper, two other linear transformations for the study of natural microbial communities are presented, which take into account the substrate concentration present in water samples. The properties of the three transformations are briefly discussed on the basis of examples from field studies. (See also W88-00208) (Author's abstract)
W88-00232

VARIABILITY IN PLANKTONIC HETEROTROPHIC ACTIVITY AND PRIMARY PRODUCTIVITY ASSAYS IN RELATION TO SAMPLING STRATEGIES,
National Board of Waters, Helsinki (Finland).
T. Talsi, T. Tamminen, and J. Kuparinen.
IN: Publications of the Water Research Institute, National Board of Waters, Helsinki, 1984. p 42-48, 1 fig, 3 tab, 24 ref.

Descriptors: *Limnology, *Water sampling, *Hydrobiology, *Plankton, *Assays, *Primary productivity, Aquatic productivity, Lakes, Glucose, Substrates, Turnover time, Sampling, Statistical analysis.

The variation in planktonic heterotrophic activity and primary productivity assays was examined in a number of studies from Finnish lakes and coastal areas. Heterotrophic activity was measured as the turnover rate or maximal uptake velocity of labelled glucose. The coefficients of variation within water samples were of the same magnitude in turnover rate measurements (mean coefficient of variation = 9.0%, number of replicates = 635) as in primary productivity assays (mean coefficients of variation = 6.8%, number of replicates = 333). The coefficients of variation between replicate samples from a sampling site were in order of 20 to 30% with all parameters. To obtain ecologically representative values for these activity parameters, replication on the sampling level is important. The replicate samples can be pooled before conducting the assays, to maintain reasonable cost and effort in the determination of parameters. A sampling strategy for heterotrophic activity and primary productivity assays in routine research is suggested. (See also W88-00208) (Author's abstract)
W88-00236

SALINITY AND PHOSPHORUS ROUTING THROUGH THE COLORADO RIVER/RESERVOIR SYSTEM,
Bureau of Reclamation, Salt Lake City, UT. Upper Colorado Region.
For primary bibliographic entry see Field 6G.
W88-00340

INFLUENCE OF LAKE POWELL ON THE SUSPENDED SEDIMENT-PHOSPHORUS DYNAMICS OF THE COLORADO RIVER INFLOW TO LAKE MEAD,
Nevada Univ., Las Vegas. Lake Mead Limnological Research Center.
For primary bibliographic entry see Field 6G.
W88-00342

HISTORICAL PATTERNS OF PHYTOPLANKTON PRODUCTIVITY IN LAKE MEAD,
Nevada Univ., Las Vegas. Lake Mead Limnological Research Center.
For primary bibliographic entry see Field 6G.
W88-00344

CHARACTERIZATION OF YAMPA AND GREEN RIVER ECOSYSTEMS: A SYSTEMS APPROACH TO AQUATIC RESOURCE MANAGEMENT,
Wyoming Game and Fish Dept., Cheyenne.
T. G. Annear, and J. M. Neuhold.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 181-192, 7 fig, 1 tab, 26 ref.

Descriptors: *Rivers, *Streams, *Ecosystems, *Productivity, Trophic level, Algae, Green River, Utah, Yampa River, Colorado, Organic matter, Stream order.

The aquatic ecosystems of two fifth order streams were studied: Yampa River, Colorado, and Green River, Utah. Autotrophy was an important source of organic energy for both rivers. No peak in productivity was seen in spring in either river. The Yampa River showed low standing crop with high turnover and export, typical of streams with little detritus accumulation, primarily periphyton production, and high gradient. The Green River showed high periphytic biomass, high production and export, with low turnover. However, both streams were similar in productivity, production efficiency, and energy transport during a large part of the year, late summer through early spring. (See also W86-02484) (Cassar-PTT)
W88-00348

EFFECTS OF LIMITED FOOD AVAILABILITY ON THE STRIPED BASS FISHERY IN LAKE MEAD,
Nevada Univ., Las Vegas. Lake Mead Limnological Research Center.
J. R. Baker, and L. J. Paulson.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 551-561, 7 fig, 1 tab, 20 ref.

Descriptors: *Reservoirs, *Lakes, *Fish populations, *Aquatic habitats, Lake Mead, Striped bass, Bass, Threadfin shad, Fish food, Food chain.

The rapid growth of the striped bass population and its exploitation of the threadfin shad in Lake Mead is described. Striped bass were introduced into the reservoir in 1969. The population rapidly increased until 1980, when fishermen noticed a decline in the number of fish caught and their physical condition. Simultaneously, the threadfin shad, abundant before introduction of the bass, had virtually disappeared in the epilimnion by 1980. However, in the sewage-enriched Las Vegas Bay area, shad were still fairly abundant during 1980, indicating that their population probably depends on the zooplankton and phytoplankton. Recent and proposed reduced nutrient levels in effluents are related to the decline in chlorophyll, which in turn affects plankton production, threadfin shad, and striped bass. (See also W86-02484) (Cassar-PTT)
W88-00365

RECORDING FATHOMETER TECHNIQUES FOR HYDRILLA DISTRIBUTION AND BIOMASS STUDIES,
Florida Univ., Gainesville. Aquatic Plants Research Center.
J. V. Shireman, and M. J. Maceina.
Miscellaneous Paper A-83-1, January 1983. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 56 p, 26 fig, 17 tab, 24 ref.

Descriptors: *Aquatic plants, *Hydrilla, *Ecosystems, *Biomass, Distribution patterns, Fathometers, Lakes, Ecology, Distribution, Fish, Plant populations, Sport fishing, Lake Baldwin, Orange Lake, Lake Pearl, Florida.

Quantitative vegetation parameters are presented to calculate hydrilla cover and biomass. It is recommended that several of these parameters be utilized to describe hydrilla relationships in a lake. Predictive equations were formulated for the three study lakes and it was concluded that the independent values taken for biomass did not indicate similar relationships in each lake. Differences in subsurface light intensity water chemistry, and substrate types may cause differences in hydrilla growth patterns which are not detectable with the fathometer. Plant density appears to be a major variable in determining plant biomass using fathometer tracing characteristics. Studies were conducted to document temporal changes in white amur and native fish populations and aquatic plant distribution associated with the introduction of white amur. White amur capture techniques including electroshocking, block netting, gill netting, and haul seining were investigated in Lake Baldwin. Although white amur were collected by all methods, none was considered effective. Hydrilla consumption rates were determined for Lake Baldwin white amur. Effective control was obtained with 185 kg fish/ha of hydrilla. Data indicate that Lake Baldwin has a harvestable bass population of 30.5 kg/ha. Condition factor analysis of largemouth bass, bluegill, and redear sunfish indicates that condition values are lower than the national average and are related, to some extent, to the amount of hydrilla present. (Author's abstract)
W88-00466

CHEMICAL AND PHYSICAL PROPERTIES OF CONNECTICUT LAKES,
Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 5C.
W88-00467

DESCRIPTION AND ASSESSMENT OF THE RAFT RIVER LOTIC SYSTEM IN THE VICINITY OF THE RAFT RIVER GEOTHERMAL AREA,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-00484

MARINE CIRCULATOR,
For primary bibliographic entry see Field 5G.
W88-00502

HCMM HYDROLOGICAL ANALYSIS IN UTAH: FIRST QUARTER REPORT.
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
Available from the National Technical Information Service, Springfield, VA 22161, as N82-32795. Price codes: A02 in paper copy, A01 in microfiche. NASA-CR-169168, 1982. 17 p, 10 fig, 2 ref.

Descriptors: *Lakes, *Infrared, *Algae, *Reflectance, *Radiometry, *Utah, *Water temperature, *Remote sensing, Satellites, Eutrophication, Plankton, Turbidity, Phytoplankton, Vegetation, Telemetry, Aerial photography, Thermal radiation, Soil water, Soil temperature, Hydrologic data collections.

This first quarter report of data from Utah Lake was based on a total of 59 images (25 day visible, 25 day infrared, and 9 night infrared scenes) spanning the period from May 13, 1978 to November 14, 1979. The first indication of the bloom appears on September 4 day visible picture. At maturity,

the algae reflectivity was as great as that of the surrounding valley vegetation to the east and greater than the mountain top to the west. Temperature calibration involved locating township and range lines and plotting them on transparent Utah Lake overlays. Temperature calibration data were obtained from the Utah State Division of Wildlife Resources and the U.S. Water and Power Resources Service. Plots of the HCMM temperature vs. total net plankton showed a semilog relationship between surface temperatures and the total algae concentrations at the same location. Temperature increased with algal concentration. Turbidity also increased with algal concentration, but no relationship between HCMM surface temperature and turbidity was found. Preliminary studies of temperature and groundwater of the agricultural area surrounding Lake Utah showed a general trend of lower temperatures near the surface. (Geiger-PTT)
W88-00658

INTERACTIONS AMONG WATERFOWL, FISHES, INVERTEBRATES, AND MACROPHYTES IN FOUR MAIN LAKES OF DIFFERENT ACIDITY,
Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team.
M. L. Hunter, J. J. Jones, K. E. Gibbs, J. R. Moring, and M. Brett.
Biological Report 80(40.20), July 1985. 80 p, 3 fig, 27 tab, 116 ref. Contract No. EPA-82-D-X0581.

Descriptors: *Acid rain, *Hydrogen ion concentration, *Species diversity, *Lakes, *Macrophytes, *Aquatic animals, *Acidic water, Species composition, Population density, Biomass, Acidity, Macroinvertebrates, Waterfowl, Ducks, Fish, Trout, Water pollution effects.

Interactions among macrophytes, zooplankton, macroinvertebrates, fish, and black ducks in Maine were studied in Salmon Pond (pH 6.3), Mud Pond (pH 4.6), Killman Pond (pH 6.5), and Unnamed Pond (pH 4.8). Macrophyte abundance and species richness varied among the ponds. The differences in species richness were probably related to pH, while transparency differences may explain the biomass patterns. Eighteen species of zooplankton were identified from Mud Pond, and 21 from Salmon Pond. Crustacean species richness was similar for both of these ponds. Annual mean abundance of benthic macroinvertebrates in Salmon and Mud ponds was similar at depths of 0.5 m but lower in Mud than in Salmon at increasing depths. Annual mean biomass was lower in Mud than Salmon at all depths. Diversity was lower in Mud than Salmon. Fish exclusion cage studies showed macroinvertebrates more abundant outside than inside cages in Mud but with similar abundance in Salmon. Sweep net samples of invertebrates available to ducklings indicated that Unnamed Pond had a significantly greater abundance and biomass than Killman Pond. Because of the absence of fishes from the acidic ponds, it seems likely that a potential competitor of ducks for aquatic foods had been eliminated. Imprinted ducklings grew faster on acidic ponds than those on the circumneutral ponds. These results support the hypothesis that ducklings and fish compete for invertebrates and that, under certain circumstances, the effect of acidification on fish may produce a beneficial effect for ducklings. (Geiger-PTT)
W88-00680

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS, REPORT 1: BASELINE STUDIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W88-00682

1985 ANNUAL REPORT.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
For primary bibliographic entry see Field 5C.
W88-00789

TROPHIC STATUS OF THE WINNEBAGO POOL LAKES, 1981,
Wisconsin Univ.-Oshkosh.
For primary bibliographic entry see Field 5C.
W88-00790

REVIEW OF TRENDS IN LAKE ERIE WATER QUALITY WITH EMPHASIS ON THE 1978-1979 INTENSIVE SURVEY,
Ohio State Univ., Columbus. Center for Lake Erie Area Research.
For primary bibliographic entry see Field 5G.
W88-00801

EMPIRICAL METHODS FOR PREDICTING EUTROPHICATION IN IMPOUNDMENTS; REPORT 3: PHASE II, MODEL REFINEMENTS,
W. W. Walker.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-155483. Price codes: A14 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, MS. Technical Report E-81-9, March 1985. Report 3 of a Series. 321 p, 91 fig, 48 tab, 89 ref, 2 append. Contract No. DACW39-78-C-0053-P006.

Descriptors: *Prediction, *Reservoirs, *Nutrients, *Model studies, *Eutrophication, Models, Nitrogen compounds, Nitrogen, Phosphorus, Oxygen depletion, Trophic level, Transparency, Organic matter, Lakes, Networks, Water quality, Chlorophyll a.

A network of models is assembled and modified for predicting reservoir-average concentrations of total N and P, chlorophyll-a, transparency, organic N, particulate P, and hypolimnetic oxygen depletion rate as functions of reservoir mean depth, hydraulic residence time, and inflow concentrations of total P, ortho-P, and total and inorganic N. Error analysis shows that the prediction of chlorophyll-a is limited more by variabilities in the biological responses to a given set of nutrient concentrations and other environmental conditions, than by uncertainties in predicting pool nutrient levels from external loadings. Inflow available P concentration and mean depth explain most of the variance in reservoir trophic state indicators and hypolimnetic oxygen status. For a given chlorophyll-a concentration and morphometry, hypolimnetic oxygen depletion rates averaged about 40% higher in reservoirs, as compared with northern lakes. Principal components analysis leads to a two-dimensional classification system for eutrophication-related water quality. Average concentrations inadequately characterize many reservoirs with pronounced spatial gradients in water quality. A computer simulation model is developed and tested for predicting longitudinal gradients in P and related trophic state indicators. Second-order sedimentation kinetics are more realistic for predicting within-reservoir spatial variations, as well as among-reservoir spatially averaged variations. (Geiger-PTT)
W88-00826

CATALOGUE OF RECENTLY DESCRIBED DIATOM TAXA FROM AFRICA AND NEIGHBOURING ISLANDS (1965-1980),
National Inst. for Water Research, Pretoria (South Africa).
F. R. Schoeman, and V. H. Meaton.
CSIR Special Report WAT 64, 1982. 61 p, 210 ref.

Descriptors: *Diatoms, *South Africa, *Africa, Phytoplankton, Systematics, Taxonomy, Catalogues, Marine Algae, Freshwater algae.

In recent years over 550 new diatom taxa have been named for the continent of Africa alone. The descriptions and illustrations of these new taxa are presented in no fewer than 75 publications, some of which are not well known, and accordingly difficult to acquire. The purpose of this catalogue, therefore, is to compile a list of diatom taxa described since 1965 for the African continent and neighboring islands (e.g. Azores, Canaries, Madagascar-Malagasy, Seychelles). The catalogue also records the synonymy given in recent African literature as well as some African taxa described prior to 1964. It is hoped that the use of this catalogue by diatomists will increase the awareness of more recent names of new taxa or combinations, thereby reducing the creation of further homonyms. (Halterman-PTT)
W88-00833

B.J. CHOLNOKY DIATOM SLIDE COLLECTION,
National Inst. for Water Research, Pretoria (South Africa).
F. R. Schoeman, and V. H. Meaton.
CSIR Special Report WAT 59, 1981. 48 p, 36 tab.

Descriptors: *Diatoms, *Africa, Taxonomy, Systematics, Catalogues, Marine algae, Freshwater algae, Algae.

During the periods of 1952 to 1972, the late B.J. Cholnoky described many new and rare diatom taxa from the African continent. The demands of modern diatom taxonomy have made it necessary to make Dr. Cholnoky's materials available for re-examination. Unfortunately, Dr. Cholnoky did not deposit slides in any herbarium, ring or mark specific specimens, or match sample numbers in publications with original sample numbers or slides made thereof. On examining his original analysis sheets, however, it was possible to determine the corresponding slide numbers for the relevant sample numbers referred to in Cholnoky's publications. To do so, a list of Cholnoky's publications for the period 1952-1970 is given in chronological order. For each reference, where material is still available, a table of the relevant slide numbers examined in that particular study is given. A list of the institutions throughout the world where Cholnoky's material is available is also provided. (Halterman-PTT)
W88-00834

REVIEW OF NUMERICAL RESERVOIR HYDRODYNAMIC MODELING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. H. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-097823. Price codes: A09 in paper copy, A01 in microfiche. Technical Report E-81-2, February 1981. Final Report. 182 p, 65 fig, 4 tab, 46 ref, 3 append.

Descriptors: *Lakes, *Model studies, *Stratification, *Reservoirs, Thermal stratification, Hydrodynamics, Mathematical models, Stratified flow, Water quality control, Finite difference methods, Finite element method, Laterally Averaged Reservoir Model, LARM model.

A two-dimensional laterally averaged model (Edinger-Buchak) was most promising in predicting reservoir hydrodynamics from the start of thermal stratification in spring to its breakup in fall. Both two- and three-dimensional, unsteady, variable density, heat-conducting models were investigated. This investigation centered on an analysis of the mathematical and numerical bases of individual models and their ability to simulate density underflow in the Generalized Reservoir Hydrodynamics flume. None of the seven three-dimensional models were suitable for economical long-term simulations. Six of the two-dimensional models came close to meeting the required criteria. However, computing time and costs were excessive. (Cassar-PTT)
W88-00842

CHARACTERIZATION OF ANAEROBIC CHEMICAL PROCESSES IN RESERVOIRS: PROBLEM DESCRIPTION AND CONCEPTUAL MODEL FORMULATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison, and J. M. Brannon.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-099674. Price codes: A05 in paper copy, A01 in microfiche.

Technical Report E-81-6, April 1981. Final Report. 80 p, 17 fig, 3 tab, 75 ref.

Descriptors: *Lakes, *Anaerobic conditions, *Reservoirs, Water quality, Model studies, Dissolved oxygen, Oxygen, Nutrients, Dissolved Oxygen Subroutine with Anaerobic Processes model, DOSAP model, Lake sediments, Sediments, Ammonia, Methanogenesis, Stratification, Destratification, CE-QUAL-R1 model, Hypolimnion, Sulfides, Phosphates, Organic matter.

Major pathways for nutrient regeneration and metal mobilization under anaerobic conditions are depicted with a model, the Dissolved Oxygen Subroutine with Anaerobic Processes (DOSAP). The model has seven linked geochemical steps or phases of increasingly anaerobic conditions. These are dissolved oxygen depletion, dissolved oxygen exhaustion, ammonium accumulation, manganese accumulation, iron accumulation, sulfate reduction, and methanogenesis. DOSAP can be used with other numerical models such as the Corps of Engineers one-dimensional reservoir water quality model, CE-QUAL-R1. To use the model for widespread field application, a broad base of data is required. Since the literature reveals little of this information, sediment studies are being done to develop this base. (Cassar-PTT)
W88-00843

LIMNOLOGICAL STUDIES AT EAU GALLE LAKE, WISCONSIN, REPORT 1: INTRODUCTION AND WATER QUALITY MONITORING STUDIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Technical Report E-85-2, March 1985. Report 1 of a Series. Edited by Robert H. Kennedy. 137 p, 49 fig, 7 tab, 17 ref, 2 append.

Descriptors: *Eau Galle Lake, *Wisconsin, *Water quality, Eutrophication, Limnology, Loading, Reservoirs, Snowmelt, Water quality, Water chemistry, Water pollution sources.

In order to assess general water quality conditions in Eau Galle Lake, Wisconsin and several of its tributaries, a monitoring program was established. The report presented here serves to document the investigation methodologies and results of the program. A detailed description of the watershed includes land use, geomorphic development, topography, soil associations, groundwater hydrology, and climatology. Limnological investigations included turbidity, suspended solids, total and particulate organic carbon, total and particulate nitrogen, total and particulate phosphorus, total calcium, magnesium, sulfate, dissolved silica, temperature, chlorophyll A, specific conductance, total alkalinity, pH, and dissolved oxygen. Samples were collected and analyzed for a period of over one year, and, for the most parameters, at depth intervals, to provide temporal and spatial variation within the lake. Overall, this reservoir is characterized as a dimictic, eutrophic lake exhibiting high algal productivity, decreased water transparency, and reduced oxygen concentrations in the bottom waters. These conditions are due to high nutrient and material loadings associated with spring runoff. (Halterman-PTT)
W88-00847

NORFOLK LAKE, ARKANSAS, TEMPERATURE ANALYSIS: MATHEMATICAL MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W88-00858

FOOD HABITS OF ADULT YELLOW PERCH AND SMALLMOUTH BASS IN NEBISH LAKE, WISCONSIN - WITH SPECIAL REFERENCE TO ZOOPLANKTON DENSITY AND COMPOSITION,
Wisconsin Dept. of Natural Resources, Madison.
S. L. Serns, and M. H. Hoff.
Technical Bulletin No. 149, 1984. 24 p, 6 fig, 13 tab, 27 ref, append.

Descriptors: *Fish diets, *Bass, *Perch, *Lakes, *Fish food organisms, Fish, Fish food, Hydrobiology, Ecology, Niches, Aquatic populations, Copepods, Crustaceans, Zooplankton, Daphnia, Population dynamics, Population density, Aquatic insects.

A 5-yr study was performed to determine the ecological relationships and compatibility of yellow perch and smallmouth bass sharing a water body, to measure zooplankton density and composition and relate that to food habits of adult yellow perch, and to examine the dietary overlap between adult yellow perch and smallmouth bass. Dipterans were the major food item of yellow perch during May-July, and cladocerans during August-September. The consumption of fishes by adult yellow perch, although never very high, was greatest during July. For smallmouth bass, insects were the most frequent item in the stomachs collected in May and June, and decapods in July-September. However, yellow perch and unidentified fishes comprised the highest percent volume of food in May, while decapods comprised the highest during June-September. Other than in 1978, when dipterans were most frequent, decapods comprised the highest frequency, volume, and index of importance each year. Dietary overlap between adult yellow perch and smallmouth bass was apparent for ephemeropterans and odonates in June and July, hemipterans and megalopterans and odonates in June and July, hemipterans and megalopterans in September, and dipterans throughout May-September. However, because of the relatively small percent of the total volume that these taxa comprised in smallmouth bass stomachs, competition for food resources between adult yellow perch and smallmouth bass in Nebish Lake would not seem to be severe. (Geiger-PTT)
W88-00872

2I. Water In Plants

TOXIC SITUATION TO LEPIDIUM SATIVUM IN THE WUPPER RIVER - A SUPPLEMENTAL METHOD OF WATER QUALITY SURVEILLANCE (DIE TOXIKOLOGISCHE SITUATION DER WUPPER GEGENUEBER DER GARTENKRESSE (LEPIDIUM SATIVUM) - EINE ERGAENZENDE METHODE DER GEWAESSERGUETEUEBERWACHUNG),
Stadtverwaltung Amt, Duesseldorf (Germany, F.R.). Chemisch-Biologische Lab.
For primary bibliographic entry see Field 5A.
W88-00071

PLANT GROWTH FACTORS IN MUNICIPAL WASTEWATER,
Arizona Univ., Tucson. Dept. of Plant Sciences.
For primary bibliographic entry see Field 3C.
W88-00085

WATER RELATIONS AND PLANT SIZE ASPECTS OF FLOWERING FOR AGAVE DESERTI,
California Univ., Los Angeles. Dept. of Biology.
P. S. Nobel.
Botanical Gazette BOGAA5, Vol. 148, No. 1, p 79-84, March 1987. 3 fig, 2 tab, 25 ref.

Descriptors: *Soil-water-plant relationships, *Plant populations, *Plant growth, *Arid lands, Deserts, Ecology, California, Precipitation, Sonora desert, Flowering, Water scarcity.

The percentage of rosettes of the monocarpic perennial Agave deserti that flowered annually in the north-western Sonoran Desert varied about 50-fold for the 8 yr considered. The number of days when the soil water potential in the root zone was above -0.5 MPa, enabling A deserti to take up water, was approximately linearly related to the annual precipitation, which also varied considerably year-to-year. The percentage of flowering in a particular year could not be predicted from the number of wet days in that year, the year before, or 3 yr before but there was a positive correlation between percentage of flowering and the number of wet days 2 yr previously Years with much flowering tended to alternate with those of little flowering. Indeed, 95% of the annual variation in the percentage of the rosettes that flowered could be accounted for by the year-to-year alternations together with the number of wet days 2 yr before the flowering. (Master-PTT)
W88-00115

DEVELOPMENT OF A TIDAL MARSH IN A NEW ENGLAND RIVER VALLEY,
Connecticut Coll., New London. Dept. of Botany.
For primary bibliographic entry see Field 2L.
W88-00135

ENVIRONMENTAL AND SOCIETAL CONSEQUENCES OF A POSSIBLE CO2-INDUCED CLIMATE CHANGE; VOLUME II, PART 8: IMPACTS OF RISING ATMOSPHERIC CARBON DIOXIDE LEVELS ON AGRICULTURAL GROWING SEASONS AND CROP WATER USE EFFICIENCIES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W88-00647

SELECTIVE BREEDING PROGRAM TO IMPROVE THE WATER-USE EFFICIENCY AND NUTRITIVE ACCEPTABILITY OF KOCHIA AS A FORAGE GRAZING CROP,
New Mexico State Univ., Clovis. Agricultural Science Center.
For primary bibliographic entry see Field 3C.
W88-00716

2J. Erosion and Sedimentation

OVERLAND FLOW AND SEDIMENT DELIVERY FIVE YEARS AFTER TIMBER HARVEST IN A MIXED CONIFER FOREST, ARIZONA, U.S.A.,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 4C.
W88-00004

STREAMBANK EROSION ALONG TWO RIVERS IN IOWA,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
A. J. Odgaard.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1225-1236, July 1987. 13 fig, 7 tab, 24 ref. Iowa State Water Resources Research Institute Project G-842-04.

Descriptors: *Stream erosion, *Bank erosion, *Rivers, *Erosion rates, *Erosion processes, *Model studies, *Iowa, Alluvial rivers, Correlation analysis, Mathematical studies, Mathematical equations, East Nishnabotna River, Des Moines River, Channel morphology, Simulation, Velocity distribution, Sediments.

Rates and processes of bank erosion were evaluated for reaches of two alluvial, equiwidth to wide bend, point bar streams in Iowa: East Nishnabotna River and Des Moines River. The evaluation was made using historical records (airphotos, maps, and streamflow records), field measurements, and soil analyses. The erosion rates were correlated with channel characteristics such as width, depth, curvature, arc angle of channel centerline, channel slope, friction factor, and degree of vegetation on the banks. The correlation was studied using the developed meander flow model. The meander flow model simulated the velocity distribution in the bends and the location of the erosion occurrences. Estimates were made of total sediment influx to the rivers from cutback erosion. Both reaches are experiencing cutbank erosion in bends at a rate of 2 to 4m/yr. The weight of the silt and clay entrained into the water from the cut banks is estimated to be 30-40% of the suspended load. The similarity between the two rivers in terms of erosion rates and patterns suggests that the findings of this study are typical for the regions. (Wood-PTT)
W88-00034

INVESTIGATION OF SAND RIDGES IN A LABORATORY CHANNEL FLOW,
O. N. Mel'nikova, O. B. Shevchenko, and A. V. Emel'yanov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 11, p 647-652, May 1987. 4 fig, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 26-29, November 1986.

Descriptors: *Sediment transport, *Bed loads, *Canals, *Channel flow, *Standing waves, *Sand waves, Model studies, Flow characteristics, Flow velocity, Erosion, Eddies.

An investigation of the formation of sandy ridges on the bottom surface of a channel flow, using a physical model, focused on the relationship between stationary waves and sand ridges. A mirror symmetric relationship was revealed: troughs of waves appeared over crests of sand ridges, and over troughs between the ridges were observed the crests of surface waves. It can be concluded that sand ridges are generated within a certain range of flow velocities due to the effect which stationary waves have on the bottom of the flow. Those ridges serve as a source for a new stationary wave structure, generating further sand ridges (the spectrum of waves and ridges thus becomes multimodal). This process continues until a stable state is achieved. The height of the sand ridge for a given depth of flow is uniquely determined by the height of the stationary waves. (Airone-PTT)
W88-00055

TECHNIQUE TO EVALUATE RISK OF EMERGENCY SPILLWAY CHANNEL EROSION,
For primary bibliographic entry see Field 8A.
W88-00072

CLIMATIC AND TECTONIC EFFECTS ON SEDIMENTATION IN A RIFT-VALLEY LAKE: EVIDENCE FROM HIGH-RESOLUTION SEISMIC PROFILES, LAKE TURKANA, KENYA,
Duke Univ., Beaufort, NC. Marine Lab.
T. C. Johnson, J. D. Halfman, B. R. Rosendahl, and G. S. Lister.
Geological Society of America Bulletin BUGMA, Vol. 98, No. 4, p 439-447, April 1987. 12 fig, 15 ref.

Descriptors: *Lakes, *Kenya, *Lake Turkana, Lake sediments, Sediments, Lake morphology, Sedimentation, Provenance, Deposition, Tectonic controls, Climates.

Approximately 900 km of 28-kHz echo sounding and 770 km of 1-kHz seismic reflection profiles were obtained from Lake Turkana in northern Kenya between March and December 1984. The profiles penetrate as much as 60 m below the lake floor, representing perhaps the last few tens of thousands of years. They show that the predominant pattern of sedimentation is one of simple and rapid basin infilling. The profiles suggest an abundance of gas (probably methane) in the Holocene sediments, particularly near the major rivers and in the deepest basins where sedimentation rates are relatively high. High-angle growth faults, characteristic of extensional regimes, are common and indicate that faulting is active today, particularly in the central basin of the lake. A major erosional unconformity indicates that lake level was about 60 m lower than present lake level, probably just prior to 10,000 yr B.P., when uncommonly arid conditions prevailed throughout much of east Africa. (Author's abstract)
W88-00110

DEPOSITIONAL MODEL FOR OUTWASH, SEDIMENT SOURCES, AND HYDROLOGICAL CHARACTERISTICS, MALASPINA GLACIER, ALASKA: A MODERN ANALOG OF THE SOUTHEASTERN MARGIN OF THE LAURENTIDE ICE SHEET,
Texas Univ. at Austin. Bureau of Economic Geology.
T. C. Gustavson, and J. C. Boothroyd.
Geological Society of American Bulletin BUCMA, Vol 99, No. 2 , p 187-200, August 1987. 11 ref, 3 tab, 83 ref. NASA Grant No. NGS 7414.

Descriptors: *Glaciology, *Sedimentology, *Sedimentation, *Glacial drift, *Paleohydrology, *Malaspina Glacier, *Alaska, *Laurentide ice sheet, *Outwash, Sediment sources, Sediment transport.

The Malaspina Glacier on the southern coast of Alaska is a partial analog of the late Wisconsinan Laurentide Ice Sheet that occupied New England and adjacent areas. Ice lobes of the Malaspina are similar in size to end moraine lobes in southern New England and Long Island. Estimated ablation rates, surface slopes, and meltwater discharge per unit of surface area for the Laurentide Ice Sheet are comparable to measured ablation rates, and meltwater discharge rates for the Malaspina Glacier. Meltwater moves from the surface of the Malaspina down-glacier and toward the bed of the glacier along intercrystalline pathways and through a series of tunnels. Regolith beneath the glacier, which is eroded and transported to the margin of the glacier by subglacial and englacial streams, is the source of essentially all fluvial and lacustrine deposits on the Malaspina Foreland. By analogy, a similar hydrologic system existed at the southeastern margin of the Laurentide Ice Sheet. Subglacial regolith, which was eroded from beneath the ice sheet by meltwater, was the source of most stratified sediment deposited in New England and adjacent areas during the late Wisconsinan. Similarly, Wisconsinan ice-contact landforms in New England were built by the same processes that are constructing landforms composed of stratified sediments in contact with the Malaspina Glacier. For the Malaspina Glacier and the Laurentide Ice Sheet, therefore, the concept of the 'dirt machine' by which debris near the base of the glacier is carried to the surface of the glacier along shear planes and then washed off the surface to form ice-contact stratified deposits is rejected. (Author's abstract)
W88-00157

ROLE OF TREE DAMS IN THE CONSTRUCTION OF PSEUDO-TERRACES AND VARIABLE GEOMORPHIC RESPONSE TO FLOODS IN LITTLE RIVER VALLEY, VIRGINIA,
Southern Illinois Univ. at Carbondale. Dept. of Geology.
For primary bibliographic entry see Field 2E.
W88-00161

ANALYSIS OF POTENTIAL SEDIMENT TRANSPORT IMPACTS BELOW THE WINDY GAP RESERVOIR, COLORADO RIVER,
New Mexico State Univ., Las Cruces.
For primary bibliographic entry see Field 6G.
W88-00343

EROSION AND SALINITY PROBLEMS IN ARID REGIONS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
For primary bibliographic entry see Field 5B.
W88-00358

ATCHAFALAYA RIVER DELTA; REPORT 3: EXTRAPOLATION OF DELTA GROWTH,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. V. Letter.
Technical Report HL-82-15, July 1982. Report 3 of a series. 114 p, 21 fig, 11 tab, 35 plates, 18 ref.

Descriptors: *Deltas, *Deposition, *Atchafalaya River Delta, *Expansion, *Sedimentation rates, Flow discharge, Sediment yield, Water depth, Regression analysis, Hydrologic data analysis.

This study predicts the future delta growth of the Lower Atchafalaya River delta based on an extrapolation of historical deposition trends in Atchafalaya Bay. The prediction is made with a regression model developed by correlating deposition rates with river discharge, sediment yield, local water depth, and location relative to the delta mass centroid. The regression model is applied to a 50-yr hydrograph using the 1977 bathymetry as initial condition. The predicted delta condition at 10-yr increments is reported. Sensitivity tests were made with the regression model which determined that the sequencing of hydrologic events had no impact on the resultant 50-yr condition, provided the total water and sediment entering the bay remained unchanged by resequencing events. It was concluded that within 50 years the delta should evolve gulfward of Eugene Island, the gulfward limit of the bay. (Author's abstract)
W88-00465

ENVIRONMENTAL FEATURES FOR STREAMBANK PROTECTION PROJECTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. E. Henderson, and F. D. Shields.
Technical Report E-84-11, November 1984. Final Report. 150 p, 49 fig, 5 tab, 118 ref, append.

Descriptors: *Bank erosion, *Stream erosion, *Bank protection, *Environmental effects, Bank stabilization, Hydraulic structures, Environmental engineering, Embankments.

This report provides guidance for incorporating environmental considerations into streambank protection projects. The stability of the streambanks of a channel is related to both site-specific and basin-wide stream reach factors. Streambank erosion or failure is a natural fluvial process that is often accelerated by changes in geotechnical or hydraulic factors and especially the activities of man. Streambank protection projects stabilize the streambank, preventing or stopping erosion. Stabilization results in a range of environmental changes. An informative review was performed to identify environmental features for streambank protection projects. Environmental features are those planning, design, construction, and maintenance procedures or practices that minimize adverse environmental impacts or enhance terrestrial and aquatic habitats and the aesthetic quality of land and water associated with streambank protection projects. Such features include structural and nonstructural designs, construction procedures that are environmentally compatible, maintenance procedures, and institutional, planning, and management approaches for streambank protection projects. Each feature is discussed in terms of concept, the purpose or appropriate use of the feature, environmental considerations, limitations to use of the feature, performance history, and cost. (Author's abstract)
W88-00468

QUANTIFYING MINOR SEDIMENT SOURCES BANK EROSION AND FLOOD PLAIN SCOUR, GREAT III,
Missouri Univ.-Rolla. Inst. of River Studies.
C. D. Morris.
Available from the National Technical Information Service, Springfield, VA 22161, as AD A121 608. Price codes: A04 in paper copy, A01 in microfiche. August 1982. 62 p, 11 fig, 8 tab, append. Contract No. DACW43-81-C-0071.

Descriptors: *Sediment transport, *Bank erosion, *Erosion, *Scour, *Mississippi River, Flood plain, Sediment yield, Mapping.

Bank erosion and/or fill was studied along the GREAT III reach of the Mississippi River between Saverton, Missouri, and Cairo, Illinois. The method used was to map the high bankline. Only small changes occurred over the 22 years studied. The five areas of change were all below St. Louis. Above St. Louis the many locks and dams have stabilized the high bankline. The areas of deposition or erosion showed changes during the first 13-year period studied (1953-56 to 1967-68). Three of the sites were above the Chester, Illinois, gage; two were below the Thebes, Illinois, gage. Deposition at four sites ranged from 277,000 to 1.1 million tons/year. Erosion at one site was 138,000 tons/year. Net deposition was about 4.4 million tons/year; net erosion, 138,000 tons/year. These figures indicate that bank erosion and deposition is not a significant factor in the total sediment budget of the river. The river's high bank is now in virtual equilibrium. (Cassar-PTT)

W88-00471

RAINSTORM RELATED TERRAIN FAILURES IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
M. Wegrzyn, J. Perez, and A. Soto-Andrews.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197638/AS. Price codes: A09 in paper copy, A01 in microfiche. Technical Completion Report, Puerto Rico Water Resources Research Institute, Mayaguez, June 1984. 166 p, 37 fig, 6 tab, 211 ref, 5 append. Project No. OWRT A-077-PR(1). Contract No. 14-34-0001-2141.

Descriptors: *Rainfall, *Landslides, *Sinks, *Puerto Rico, *Sinkholes, Soil solution, Leachates, Land depression, Subsidence, Terrain failures.

A study of sinkhole related terrain failures in the blanket sand plains of North-Central Puerto Rico was conducted between September 1, 1982 and May 31, 1983. An effort was made to determine the relation between the appearance of sinkholes, intensity of rainfall, and ground water fluctuations. Multiple study methods comprised aerial photography reconnaissance, examination of geological, hydrogeological and topographical maps, inventory of selected sinkholes, and laboratory soils tests, seismic refraction and electric resistivity survey. Sinkholes were found to be related to rainstorm but not to water table fluctuations. They formed from the collapse of soil into underlying open passages. The largest sinkhole observed occurred in Parcelas Marquez, a rural housing development at the site of previous collapse failures which appeared as a large, shallow depression in 1936 aerial photography. Boreholes drilled in the area showed that collapse will keep on occurring in the development, with probable high losses of property. The area comprised is 4.1 square kilometers. (Wegrzyn-PR WR RI)
W88-00545

FIELD EVIDENCE FOR THE FLOW PROPERTIES OF THE TOUTLE VALLEY MUDFLOWS,
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2E.
W88-00651

GEOMORPHIC PROCESSES AND EVOLUTION OF BUTTERMILK VALLEY AND SELECTED TRIBUTARIES WEST VALLEY, NEW YORK: FLUVIAL SYSTEMS AND EROSON STUDY, PHASE II,
Earth Surface Research, Inc., Narragansett, RI.
J. C. Boothroyd, B. S. Timson, and L. A. Dunne.
Available from the National Technical Information Service, Springfield, VA 22161, as NUREG/CR-2862. Price codes: A09 in paper copy, X00 in microfiche. Nuclear Regulatory Commission, Washington, DC. Office of Nuclear Regulatory Research. July 1982. 107 p, 20 fig, 9 tab, 6 append, 10 plates, 12 ref. Contract No. FIN B6350; NRC-04-79-105.

Descriptors: *Fluvial sediments, *Erosion, *Sedimentation, *Channel morphology, *New York, Soil erosion, Soil mechanics, Channel erosion, Radioactive waste disposal, Suspended sediments, Landslides.

Repetitive bar and channel mapping at several scales, clast size and movement measurements, suspended-sediment sampling, and stream gaging of a 5 km reach of Buttermilk Creek and selected tributaries at West Valley, New York, have been carried out to determine short-term depositional and erosional processes as well as long-term valley changes adjacent to the low-level nuclear waste disposal site and other areas of the Western New York Nuclear Service Center. Changes to bar-and-channel geometry in Buttermilk Creek are the results of migration of large transverse bars in equilibrium with large floods. Large amounts of lower terrace gravel are also recycled during these events. Downslope movement of landslides by slumping and earthflow appears to be a continuous process (1.5 cu m/yr). Quantitative values of bedload transport, suspended-load sediment transport, and reservoir infill rates compare well with a simple denudation rate (6600 cu m/yr). The middle-to-high-level fluvial terraces in Buttermilk Creek are either adjacent to tributary confluences and preserved by an excess of bedload over transport capacity, or survive because the channel is stable on the opposite side of the valley for unknown reasons. The convex longitudinal profile of Franks Creek/Erdman Brook suggests that it is unstable and will continue to downcut rapidly. Valley widening will occur by parallel retreat of slopes. The future lowering of Buttermilk Creek is controlled by bedrock floors in Cattaraugus Creek and lower Buttermilk Creek. However, tributary lowering and widening will continue independent of a change in base-level of Buttermilk Creek. (Author's abstract)
W88-00653

SEDIMENT AND RADIONUCLIDE TRANSPORT IN RIVERS: RADIONUCLIDE TRANSPORT MODELING FOR CATTARAUGUS AND BUTTERMILK CREEKS, NEW YORK,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-00655

METHODS OF COMPUTING SEDIMENTATION IN LAKES AND RESERVOIRS.
United Nations Educational, Scientific and Cultural Organization, Paris, France, February 1985. 224 p. Edited by Stevan Bruk.

Descriptors: *Reservoir silting, *Reservoir operation, *Sedimentation, *Erosion, *Prediction, Lakes, Economic aspects, Reservoir storage, Symposiums, Stream erosion, Erosion control, Reservoirs.

This book is a special report of the Unesco International Hydrological Program (IHP) aimed at reviewing methods of computing sedimentation in lakes and reservoirs. The report includes recommendations on appropriate ways to prevent or reduce silting of reservoirs during their operation. The chapters of the report discuss the following topics: technical and economic impact of reservoir sedimentation; physical processes of reservoir sedimentation; field measurements; methods of predicting downstream erosion, reservoir sedimentation, and storage recovery; and conclusions and recommendations. The contents of the report were discussed at the first meeting of the IHP members at Unesco, Paris, 1981, and later revised at the second meeting in 1982. The report was completed and submitted in a preliminary form for discussion at a special session of the Second International Symposium on River Sedimentation, Nanjing, October 1983. In the final report, the authors responded to the comments and suggestions made during the discussions at Nanjing. A proposal of the follow-up activities worked out at the meeting in Nanjing is included in the last chapter of the present report. (See W88-00695 thru W88-00699) (Geiger-PTT)
W88-00694

TECHNICAL AND ECONOMIC IMPACT OD RESERVOIR SEDIMENTATION,
Electricite de France, Beziers.
J. Evrard.
IN: Methods of Computing Sedimentation in Lakes and Reservoirs, UNESCO, 1985. p 1-10.

Descriptors: *Reservoirs, *Sedimentation, *Environmental effects, *Dam effects, *Economic aspects, Silting, Reservoir storage, Reservoir operation, Erosion, Social aspects, Ecological effects, Environmental impact statement, Dams, Public health, Sediment transport, Lake sediments.

The construction of a dam in the river valley causes a modification of the regime of river discharges, a transformation of river channel morphology in the zone of the reservoir, and a significant change of the conditions of sediment transport. The effects of impoundment on the reservoir, the river reach upstream and downstream from the reservoir, and the influence of sediments on the aquatic biocenosis are considered. Sediment deposits may affect the safety of the dam. The influences of sediment deposits on the bottom outlets, gates and valves, the dam itself, and the underwater supervision of the dam by television cameras, submersibles or divers are considered. The impact of reservoir sedimentation on the social and economic objectives of the project depends upon the size and the characteristics of the deposits. The consequences are very complex, because the dam usually serves multiple objectives which may evolve over the years. The effects of impoundment on energy production, agriculture and industry, public health, and discharge regulation are discussed. The effects of sedimentation on the reduction of the water surface, water sports, and fire fighting are discussed. (See also W88-00694) (Geiger-PTT)
W88-00695

PHYSICAL PROCESSES OF RESERVOIR SEDIMENTATION,
Dundee Univ. (Scotland).
J. McManus.
IN: Methods of Computing Sedimentation in Lakes and Reservoirs, UNESCO, 1985. p 11-39, 8 fig, 2 tab, 72 ref.

Descriptors: *Reservoirs, *Sedimentation, *Sediment erosion, *Sediment transport, *Lake sediments, Silting, Reservoir operation, Bank erosion, Erosion, Dams, Dam effects, Environmental effects, Bottom sediments.

In the 'flooded valley' reservoir, high density flows may sweep the floor of the entire basin to give sediment deposits against the back wall of the dam. In the 'expanded lake' reservoir, such flows may enter the principal or subsidiary basins and their loads are retained in the dead storage areas remote from the dam. The nature of sediment supply to a reservoir will depend on numerous variables such as bed slope, shear stress, fluid discharge, velocity, intensity of turbulence, fluid temperature, particle size, and bed configuration. The morphological effects of river impoundment are discussed in terms of aggradation above the reservoir and degradation below the reservoir. The movement of sediments in reservoirs depends on wind effects, solar heating, and river inputs. The geomorphology of lake floor deposits are generally unique for each lake. Cliff-foot erosion of lakes and reservoirs causes shoreline retreat through collapse of unstable undercut slopes, especially in wet weather, and leads to the growth of reservoir margin beaches. Banks of waterside shorelines carried off through generated landslides are marched further into the reservoir during drawdown below the normally occurring water levels. Ice blocks may also incorporate shoreline sediment and carry it away to deeper parts of the reservoir before melting. (See also W88-00694) (Geiger-PTT)
W88-00696

FIELD MEASUREMENTS,
Geological Survey, Jackson, MS. Water Resources Div.
H. E. Jobson.
IN: Methods of Computing Sedimentation in Lakes and Reservoirs, UNESCO, 1985. p 41-63, 2 fig, 55 ref.

Descriptors: *Sediment transport, *Lake sediments, *Reservoirs, *Sedimentation rates, *Suspended load, Fluvial sediments, Sediments, Suspended sediments, Bottom sediments, Measuring instruments, Sediment-carrying capacity, Sedimentation, Remote sensing, Sediment discharge, Sediment sampler, Sediment load.

Sediment is carried into a lake by streams and rivers as well as by overland flow entering a lake. The surest way of obtaining an accurate determination of the amount of sediment being carried to a lake by streams is to measure the flow rate and sediment concentration of the inflowing waters just upstream of the lake. Measurements of fine sediment concentrations usually involve collecting a sample of the water-sediment mixture, separating the sediment, and weighing. The rate of transport of coarse material is related to the water discharge

but tends to be highly variable both with time and position in the river. The suspended load can be sampled using procedures similar to those for fine sediment except for two special considerations. First, because of the inertia of the coarse particles a representative sample can only be obtained if the intake velocity to the sampler is equal to the flow velocity at the point of measurement. The second consideration which must be considered is that the suspended coarse material tends to have a large spatial variability, especially in the vertical direction. Methods of surveying the accumulation of sediments in reservoirs are discussed. Carbon 14 dating of sediments and remote sensing methods have helped to monitor sediment accumulation rates in reservoirs. Techniques for determining sediment density, particle size, water currents, and residence time of sediments in reservoirs are discussed. (See also W88-00694) (Geiger-PTT)
W88-00697

METHODS OF PRESERVING RESERVOIR CAPACITY,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
F. Jiahua.
IN: Methods of Computing Sedimentation in Lakes and Reservoirs, UNESCO, 1985. p 65-164, 65 fig, 18 tab, 62 ref.

Descriptors: *Reservoir capacity, *Reservoir silting, *Reservoir operation, *Lake sediments, *Erosion control, Siphons, Soil conservation, Soil stabilization, Sediment erosion, Dam design, Sedimentation, Silting, Flow regulators, Flushing, Dredging.

Several methods of preserving reservoir capacity are discussed with examples of each from different dams and reservoirs. Sediment deposition in a reservoir may be reduced by soil conservation methods, trapping sediments in a vegetative screen, and bypassing heavily sediment-laden flows. Methods of maximizing sediment through-flow include flow regulation during floods (by both controlled and uncontrolled flow schemes), drawdown flushing, density current flushing, and the release of sediments through bottom outlet structures in dams. The recovery of storage in reservoirs may be accomplished by flushing deposited sediments, dredging, and siphoning. Siphoning may be done by hydraulic siphons, siphon dredgers, or the Jandin method which involves the siphoning of sediment deposits through the dam. (See also W88-00694) (Geiger-PTT)
W88-00698

PREDICTION METHODS,
Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
S. Bruk.
IN: Methods of Computing Sedimentation in Lakes and Reservoirs, UNESCO, 1985. p 165-210, 22 fig, 55 ref.

Descriptors: *Prediction, *Sedimentation, *Mathematical models, *Reservoir silting, *Reservoir design, Lake sediments, Erosion, Bank erosion, Reservoirs, Reservoir operation, Design criteria, Decision making, Dam construction, Reservoir capacity, Bank erosion, Stability, Models.

The objectives of prediction of reservoir sedimentation are different in the planning, design, and operation stages of the water resources project. In general, the objective decisions on reservoir sedimentation is to minimize the expected risk of inadequate performance of the system through optimal choice of decisions by which the system performance can be influenced. Predictions of reservoir sedimentation are inherently probabilistic. The prediction of reservoir sedimentation may be accomplished by empirical methods or mathematical models. The prediction of storage recovery and preservation may be accomplished by an unsteady flow model of reservoir emptying and flushing. A special simplified calculation method is proposed for the case of retrogressive erosion in reservoirs. Although a full mathematical description of the appearance, propagation, modification and outflow of density currents is still not possible, the basic equations may be used to obtain reasonably fair predictions with the use of some assumptions and semi-empirical approximations. Predictions of downstream erosion are discussed in terms of erodibility of the river bed, density of the bed material, stability of the armor layer, stability of river banks, downstream control, characteristics and sediment content of the flow released from the reservoir, bed roughness, channel modifications, and other influences. (See also W88-00694) (Geiger-PTT)
W88-00699

ECONOMIC DIFFERENCES BETWEEN CUMULATIVE AND EPISODIC REDUCTION OF SEDIMENT FROM CROPLAND,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
P. I. Wu, J. B. Braden, and G. V. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-214938/AS. Price codes: A07 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana, UILU-WRC-86-204, WRC Research Report No. 204, September 1986. 129 p, 7 fig, 39 tab, 89 ref, append. State Project No. S-099-Ill.

Descriptors: *Economic evaluation, *Sediment control, *Sediment loads, Agriculture, Sediment, Optimization, SEDEC model, Model studies, Costs, Grass crops, Cropland, Cultivated lands.

Measures for reducing cumulative sediment loads from cropland and compared with measures for reducing sediment loads from extreme storms. The issue is whether the optimal means of controlling cumulative loads are very different from the optimal control for storm event loads. Differences are described in terms of costs and management practices. The analysis entailed developing a storm-event simulation model analogous to the SEDEC sedimentation economics model. The analogue model was used to identify the respective optimal cropland management strategies for various extreme storm conditions. These strategies were then analyzed using the annual average SEDEC, and the optimal strategies from SEDEC were analyzed for their storm-event properties. The comparisons permit conclusions concerning the relative effectiveness of management strategies for achieving cumulative sediment goals versus storm-event load goals. The study produced four main conclusions. First, control costs for episodic sediment loads were consistently higher than the costs for proportionate reductions in annual average loads. Strategies for reducing cumulative loads generally achieve less than proportionate reductions in cumulative loads. Second, the highest control costs were generally for the most extreme storms. Third, contour cultivation is a key element of efficient management strategies for row crops. Finally, where a permanent grass crop is grown adjacent to the stream, there is generally little more to be gained by changing upslope management practices. This suggests that grass strips along streams would greatly reduce the need to modify farming practices elsewhere in order to limit sedimentation. (Stout-IL WRC)
W88-00729

LONG TERM SEDIMENT DEPOSITION IN THE RIPARIAN ZONE OF AN AGRICULTURAL WATERSHED,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. Lowrance, J. K. Sharpe, and J. M. Sheridan.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-216950. Price codes: A06 in paper copy, A01 in microfiche. Georgia Environmental Resources Center, Atlanta, Technical Report ERC No. 03-84, July 1984. 92 p, 23 fig, 10 tab, 51 ref, append. Contract No. 14-08-0001-G836. Project No. USGS G836-05.

Descriptors: *Sediment transport, *Riparian waters, *Nonpoint pollution sources, *Agricultural watersheds, Water quality, Erosion, Management, Farm management, Soil erosion, Georgia, Little River Research watershed.

Sediment deposition over the past 100 years was measured on a coastal plain agricultural watershed, part of the Little River Research Watershed in Turner County, Georgia. Three approaches were used to estimate long term sediment deposition: (1) determine the changes in depth to argillic horizon along transects from fields to streams; (2) estimate 100 year upland erosion with the Universal Soil Loss Equation and use a sediment delivery ratio to calculate mass of deposition; and (3) use radiometric dating techniques to estimate the ages of deposited materials. Estimates from the radiometric dating ranged from 128 million gal/ha/yr to 544 million ga/ha/yr. Estimates of changes in depth to the agrillic horizon along nine transects yielded a mean of 51.7 million gal/ha/yr with a range of 7.6 to 92.1 million gal/ha/yr. The average annual rate for the estimate of gross erosion minus sediment delivery was 34.8 million gal/ha/yr. From these data it is concluded that the average annual rate of sediment deposition on this watershed during 1880-1979 was 35 to 52 million gal/ha/yr. The actual quantities at any one point can range much higher, perhaps up to 550 million gal/ha/yr. These data suggest that riparian ecosystems are important sinks for agricultural chemicals (nutrients and pesticides) associated with these sediments. (Author abstract)
W88-00742

EROSION STUDIES OF PIPE LINING MATERIALS: FIFTH PROGRESS REPORT,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
For primary bibliographic entry see Field 8G.
W88-00780

EVALUATION OF THE FLUID DYNAMIC PROPERTIES OF MUD FLOWS ON MOUNT ST. HELENS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
T. E. Lang, and J. D. Dent.
March 1983. Final Report. 78 p, 7 tab, 32 fig, 22 ref, 4 append Contract No. 14-4-0001-1471.

Descriptors: *Sediment transport, *Mudflows, *Volcanoes, *Erosion, Mt. St. Helens, Fluid dynamics, Model studies, Pine Creek, Muddy Creek, Toutle River, Swift Reservoir, Washington, Reservoirs, Flow measurement.

Findings of a computer-based study of the mudflows after the Mt. St. Helens eruption on May 18, 1980, are summarized: Part I, startup dynamics and mudflow down the drainages; Part II, the termination of the Pine Creek mudflow into Swift Reservoir. Parameters of the mudflow in Muddy Creek, Pine Creek and Toutle River drainages were evaluated in order to establish a basis for general analysis of mud flow phenomena. Initiation of flow was approximated, considering the snow deposition and the characteristics of the pyroclastic eruption. Different aspects of the computer modeling were evaluated for the different drainages. Then for the North and South Toutle River drainages, equilibrium flow conditions were established, from which kinematic viscosity and the Manning's numbers of the flows were determined. For the East Pine Creek and Muddy River drainages, a complete flow analysis was carried out which included initiation of flow, progression of the flow through the channels, and final terminal flow into Swift Reservoir. Time sequencing of the flows with reservoir elevation changes was correlated. Additionally, kinematics of the flows were compared with corresponding field measured quantities where possible. In part II the mudflow from Pine Creek was modeled as it terminated into Swift Reservoir. Flow conditions from part I were used as initial conditions for modeling the mudflow from Pine Creek to Swift Reservoir. A two-dimensional, incompressible, linear viscous computer model was used to evaluate the interaction between the inflowing mud and the stationary reservoir. This analysis produced an amplitude and velocity of the resulting surge wave that agrees with the observed recordings of the event. (Cassar-PTT)
W88-00815

NORFOLK HARBOR AND CHANNELS DEEPENING STUDY; REPORT 2: SEDIMENTATION INVESTIGATION, CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2L.
W88-00828

ESTIMATIONS OF STORM RUNOFF AND SEDIMENT YIELD FOR SELECTED SMALL DAM SITES IN KWAZULU,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W88-00829

PROCEDURES FOR PREDICTION OF CONSOLIDATION IN SOFT FINE-GRAINED DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
For primary bibliographic entry see Field 8D.
W88-00838

ENGINEERING GEOLOGY AND GEOMORPHOLOGY OF STREAMBANK EROSION: REPORT 3, THE APPLICATION OF WATERBORNE GEOPHYSICAL TECHNIQUES IN FLUVIAL ENVIRONMENTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
J. R. May.
Technical Report GL-79-7, February 1982. 239 p, 122 fig, 28 ref.

Descriptors: *Bank erosion, *Rivers, *Stream erosion, *Acoustics, *Geophysics, *Seismology, *Sonar, Hydraulic equipment, Erosion, Hydraulic machinery, Streams, Physical properties, Channel erosion, Geology, Seismic properties.

The performance, application, and capability of selected waterborne acoustic profiling systems for streambank erosion studies in fluvial environments were evaluated on areas of the White River, Lower and Middle Mississippi River, Missouri River, and the Ohio River. The application of continuous seismic reflection profiling (CSRP) and side-scanning sonar systems revealed that the state of the art of these systems is sufficiently developed for application to streambank erosion studies, as well as other engineering, geologic, hydrologic, and hydraulic investigations in the fluvial environment. The CSRP method allows detection and identification of stratigraphic and structural geology, and to a lesser extent, lithologic features on and below the channel bottom. CSRP systems were found to be well suited for locating bedrock below the channel bottom. Side-scanning sonar systems are useful in determining overall channel bottom characteristics as well as natural and man-made features. CSRP and side-scanning sonar systems can be successfully applied for periodic routine or special purpose monitoring. Acoustic profiling surveys can be significant where streambank erosion, subaqueous failures, or other adverse fluvial conditions are persistently active or have been intermittently active historically. (Geiger-PTT)
W88-00849

NEWBURYPORT HARBOR, MASSACHUSETTS, REPORT 2: DESIGN FOR HYDRODYNAMICS, SALINITY, AND SEDIMENTATION; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W88-00855

ATCHAFALAYA RIVER DELTA, REPORT 10: WAVE HINDCASTS; MAIN TEXT AND APPENDICES A AND B,
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 2L.
W88-00860

ELEMENTAL COMPOSITION OF SUSPENDED PARTICULATE MATTER IN THE LOWER DUWAMISH RIVER AND ELLIOT BAY, WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W88-00876

2K. Chemical Processes

HYDROGEOLOGY AND GEOCHEMISTRY OF THE OGALLALA AQUIFER, SOUTHERN HIGH PLAINS,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W88-00005

CARBON-14 DATING OF SOME HOT SPRING WATERS FROM THE EASTERN PYRENEES (SOUTHERN FRANCE) (MESURES DE C-14 DANS QUELQUES EAUX THERMALES DES PYRENEES-ORIENTALES),
Ecole Nationale Superieure de Geologie Appliquee et de Prospection Miniere, Nancy (France).
For primary bibliographic entry see Field 2F.
W88-00049

MODELS FOR THE DISSOLUTION OF CARBONATE ROCKS AND THE C-13/C-12 EVOLUTION OF CARBONATE GROUND WATERS (MODELLE DER KALK-AUFLOESUNG UND C-13/C-12-ENTWICKLUNG VON KARBONAT-GRUNDWAESSERN),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
K. W. Schaefer, and E. Usdowski.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 20, No. 2, p 69-81, June 1987. 15 fig, 28 ref.

Descriptors: *Karst hydrology, *Geochemistry, *Carbonates, *Carbonate rocks, *Carbon cycle, *Soil gases, *Carbon radioisotopes, *Air pollution effects, Acid rain, Groundwater, Chemical reactions, Sulfuric acid, Carbon dioxide, Sulfates, Sulfur compounds.

The subsurface dissolution of carbonate rocks is essentially controlled by dissolved biogenic CO2, and occurs in hydrogeochemical systems which stand between two limiting cases. In industrial areas an additional dissolution by dissolved sulfur oxides from atmospheric pollution may occur. A model of these processes requires data on the composition of groundwater with respect to its major components as well as data on the stable carbon isotopes of the dissolved carbonate, the carbonate rocks, and the soil CO2 in the recharge area. It is further necessary to determine the quantities of the dissolved sulfate of geogenic and anthropogenic origin. The formal treatment of quantitative model considerations for various hydrogeochemical situations was deduced using the system CaCO3-CO2-SO3-H2O. (Author's abstract)
W88-00068

DEPOSITION BOTH WET AND DRY.
For primary bibliographic entry see Field 5B.
W88-00222

COMPARISON OF WET DEPOSITION COMPOSITION AT COASTAL AND INLAND SITES IN EAST-CENTRAL FLORIDA,
University of Central Florida, Orlando. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-00226

NATURE OF PRECIPITATION AND ATMOSPHERIC PARTICULATES IN CENTRAL AND NORTHERN NEW MEXICO,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-00227

OSCAR EXPERIMENT,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-00228

SOLUBILITY OF METAL IONS IN RAIN-WATER,
Illinois State Water Survey Div., Champaign. Atmospheric Chemistry Section.
For primary bibliographic entry see Field 5B.
W88-00229

CALCIUM CARBONATE PRECIPITATION IN RESERVOIRS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
G. R. Dutt, and D. M. Hendricks.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 475-490, 14 fig, 4 tab, 6 ref.

Descriptors: *Chemical precipitation, *Calcite, *Calcium carbonate, *Reservoirs, Geochemistry, Solubility, Aragonite.

Calcite precipitation was studied by immersing polyethylene bags filled with varying concentrations of calcium for up to 26 days in synthetic Lake Powell water. Original concentrations of calcium were 0 to about 350 ppm. Calcite was identified in several of the bags and aragonite in one sample. It was concluded that lake water can become supersaturated so that aragonite precipitates and eventually decays to form calcite. A buoy for measuring precipitation in the field was developed and tested. (See also W86-02484) (Cassar-PTT)
W88-00361

NATURAL SALINITY REMOVAL IN MAINSTEM RESERVOIR: MECHANISMS, OCCURRENCE, AND WATER RESOURCES IMPACTS,
Utah Water Research Lab., Logan.
J. J. Messer, E. K. Israelsen, and V. D. Adams.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 491-515, 3 fig, 6 tab, 38 ref.

Descriptors: *Chemical precipitation, *Geochemistry, *Water quality control, *Calcite, *Calcium carbonate, *Salinity, *Reservoirs, Nutrients, Water temperature, Coagulation, Temperature, Photosynthesis, Dissolved solids, Colorado River, Lake Powell, Lake Mead, Bighorn Lake, Oneida Narrows Reservoir, Flaming Gorge Reservoir, Canyon Reservoir, Water management.

Salinity is removed from surface waters in transit through reservoirs by precipitation, coprecipitation, coagulation, and bioassimilation. Calcite precipitation driven by pH increases from photosynthesis or by increasing temperature appears to be the most important salinity removal mechanism. This is probably more important in the newer Flaming Gorge and Lake Powell reservoirs than in the older Lake Mead. Although calcium carbonate removal can reduce damages from corrosion of pipes and boilers, it may aggravate conditions in agricultural regions. Removal of calcium without removal of sodium increases the exchangeable sodium percentage, harming soil structure. Promising methods of calcite removal include maintaining a high pH through increased photosynthesis and maintaining a high surface temperature through hypolimnetic releases. However, these tactics have far-reaching and competing effects on temperature and nutrient dynamics. A desirable removal

method may be reducing the concentration of natural phenolic organic compounds that inhibit calcite precipitation. (See also W86-02484) (Cassar-PTT)
W88-00362

CHEMISTRY OF PARTICLES.
For primary bibliographic entry see Field 5B.
W88-00371

THERMODYNAMIC EQUILIBRIUM PROPERTIES OF AQUEOUS SOLUTIONS OF NITRATE, SULFATE AND AMMONIUM,
Exxon Research and Engineering Co., Florham Park, NJ.
For primary bibliographic entry see Field 5B.
W88-00372

ACIDIC AEROSOLS: OXYGEN-18 STUDIES OF FORMATION AND INFRARED STUDIES OF OCCURRENCE AND NEUTRALIZATION,
Argonne National Lab., IL. Chemical Technology Div.
For primary bibliographic entry see Field 5B.
W88-00373

STUDIES OF SULFUR DIOXIDE AND NITROGEN REACTIONS IN HAZE AND CLOUD,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 5B.
W88-00374

OBSERVATIONS ON ACID PARTICLES AND DROPLETS IN THE ATMOSPHERE,
Deutscher Wetterdienst, Hamburg (Germany, F.R.). Meteorologisches Observatorium.
For primary bibliographic entry see Field 5B.
W88-00375

ACIDIFICATION OF RAIN BY OXIDATION OF DISSOLVED SULFUR DIOXIDE AND ADSORPTION OF NITRIC ACID,
Environmental Protection Agency, Research Triangle Park, NC.
For primary bibliographic entry see Field 5B.
W88-00376

SOLUBILITY OF ATMOSPHERIC PARTICULATE MATTER,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5B.
W88-00377

SOLUTION-MINERAL EQUILIBRIA IN THE STAMPRIET ARTESIAN BASIN,
National Inst. for Water Research, Bellville (South Africa). Cape Regional Lab.
G. Tredoux.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 127-133, 2 fig, 7 ref.

Descriptors: *Geochemistry, *Water quality, Confined aquifers, South Africa, Montmorillonite, Calcite, Kaolinite, Stampriet Basin, Silica, Chemical equilibrium, Aquifer characteristics, Geohydrology, Minerals.

Mineral-water stability diagrams were constructed for the Stampriet Artesian Basin, South Africa. The water in all three aquifers tends to be in equilibrium with kaolinite. Some of the water in the Kalahari beds seems to be in equilibrium with montmorillonite. Both illite and kaolinite are present in the sediments of the Karoo Succession. Although illite has a pronounced effect on the potassium concentration, kaolinite seems to be controlling the hydrochemistry. Water in the Kalkrand basalt displays a distinct chemical relationship with montmorillonite. All groundwaters in the aquifers are saturated with respect to calcite. (See also W88-00373) (Cassar-PTT)
W88-00399

CHARACTERIZATION OF CLIMAX GRANITE GROUND WATER,
Lawrence Livermore National Lab., CA.
D. Isherwood, J. Harrar, and E. Raber.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001916. Price codes: A05 in paper copy, A01 in microfiche. UCRL-53309, UC-70, July 1982. 94 p, 9 fig, 8 tab, 22 ref, 2 append.

Descriptors: *Geochemistry, *Chemical properties, *Groundwater, *Radioactive waste disposal, Granite, Climax groundwater, Nevada Test Site, Dissolved solids, Uranium.

To evaluate the potential of granite as a host rock for a nuclear waste repository, Climax granite groundwater obtained from five locations at the Nevada Test Site was characterized. Contrary to commonly held views on the nature of deep granitic groundwaters, Climax water was neither dilute nor in equilibrium with the granite. Concentrations of total dissolved solids were high, 1200 to 2160 mg/L, (sodium, 56-250 mg/L; calcium, 114-283 mg/L; sulfate, 325-1060 mg/L). Uranium levels were high in two samples (1.8 and 18.5 mg/L) and below the detection level in the other three samples. pH was 7.3-8.2. The wide differences in composition between samples suggest that the samples came from different and independent fracture systems. However, sodium concentrations tended to increase with depth as calcium and magnesium concentrations decreased. With the two samples tested, waters appeared to be less oxidizing with depth (+410 mV at 420 m below the surface and +86 mV at 565 m). Isotopic analyses showed that the waters are of meteoric origin. Sulfate probably originated from pyrite. Computer analysis indicated that the waters were not in equilibrium with the total mineral assemblage but supersaturated with respect to calcite, quartz, kaolinite, muscovite, K-feldspar, and others. The heterogeneity and unusual character of the groundwater at this site show the necessity for more extensive testing to properly characterize the geochemical environment. (Cassar-PTT)
W88-00481

PHYSICS AND CHEMISTRY OF ACID PRECIPITATION,
SRI International, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W88-00485

CHROMIUM VALENCY RESPONSE AND ENVIRONMENTAL FATE IN THREE-PHASE AQUATIC MICROCOSMS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5B.
W88-00547

ISOTOPIC, CHEMICAL AND DISSOLVED GAS CONCENTRATIONS IN GROUNDWATER NEAR BEAUFORT WEST,
National Physical Research Lab., Pretoria (South Africa).
For primary bibliographic entry see Field 2F.
W88-00947

2L. Estuaries

TEMPORAL CHANGES IN LITTORAL MEIOFAUNA FROM THE HUNTER RIVER ESTUARY,
Australian National Univ., Canberra. Dept. of Zoology.
M. Hodda, and W. L. Nicholas.
Australian Journal Marine Freshwater Research AJMFA4, Vol. 37, No. 6, p 729-741, 1986. 3 fig, 4 tab, 18 ref.

Descriptors: *Estuarine environment, *Nematodes, *Copepods, *Australia, Hunter river estuary, Meiofauna, Littoral environment, Temporal distribution, Seasonal variation.

The fluctuations in the densities of meiofaunal nematodes and copepods from seven sites on the Hunter River estuary over one year are described. There were no consistent patterns of change in either the densities of any copepod genus or total number of copepods. There were large fluctuations in the total number of nematodes at the various sites throughout the year, but a consistent pattern applicable to all sites was lacking. A few species of nematode, mostly epistrate feeders, each showed consistent changes in density at all sites over the year, but most epistrate feeders did not. The density of most species changed during the year, but these changes could not be consistently related to the seasons, and it is suggested that non-seasonal environmental changes are of greater significance. These findings contrast with those made on estuaries in other parts of the world, probably as the result of the presence of mangroves and the mild climate. The densities of a few species of nematode did not change throughout the year, and the total density of nematodes and copepods was strongly influenced by the height above low tide mark, with greatest numbers close to the low tide mark. (Author's abstract)
W88-00001

DISTRIBUTION AND COMMUNITY STRUCTURE OF THE BENTHIC FAUNA OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE DESCRIBED BY NUMERICAL METHODS OF CLASSIFICATION AND ORDINATION,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 2H.
W88-00047

ELEMENTARY CHEMICAL COMPOSITION (C, H, N) AND ENERGY EQUIVALENT OF ACARTIA CLAUSI (CRUSTACEA: COPEPODA), AN IMPORTANT SPECIES IN THE BIOENERGETICS OF THE COASTAL ECOSYSTEMS OF THE NORTHWEST MEDITERRANEAN (COMPOSITION CHIMIQUE ELEMENTAIRE (C, H, N) ET EQUIVALENT ENERGIE D'ACARTIA CLAUSI (CRUSTACEA: COPEPODA), ESPECE IMPORTANTE DANS LA BIOENERGETIQUE DES ECOSYSTEMES COTIERS DE MEDITERRANEE NORD-OCCIDENTALE),
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 5C.
W88-00048

SIMULATION OF SALTMARSH WATER COLUMN DYNAMICS,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
D. L. Childers, and H. N. McKellar.
Ecological Modelling ECMODT, Vol. 36, No. 3/4, p 211-238, May 1987. 7 fig, 3 tab, 85 ref. NSF Grant No. BSR-8012165.

Descriptors: *Model studies, *Simulation, *Organic carbon, *Nitrogen, *Water exchange, *Salt marshes, Wetlands, Estuaries, Tidal rivers, Coastal marshes, Model studies, Nitrogen cycle, Detritus, Oysters, Coasts, Plankton, Dynamics.

A deterministic model of water column dynamics in saltmarsh tidal creeks focuses mainly on mechanisms of carbon and nitrogen cycling within the water. The model includes biotic interactions among phytoplankton, zooplankton, dissolved inorganic nitrogen, detritus, and dissolved organics. The model also examines the effects of tidal exchange with the nearshore coastal ocean. In simulation experiments, the model isolates the water column submodel from simulated vegetated marsh surface, oyster reefs, and subtidal benthos. By comparing simulation results with field data from the North Inlet saltmarsh (Georgetown County, SC), the relative importance of water column processes in controlling seasonal changes observed in the tidal creeks was examined. Results suggest that for the components with rapid biotic turnover rates (phytoplankton and dissolved inorganic nitrogen) much of the observed seasonal pattern is controlled by internal cycling within the water column (planktonic productivity, nutrient uptake and re-

mineralization). For components with slower turnover rates (zooplankton, detritus, and dissolved organic matter), tidal exchange with the coastal ocean plays a larger role in controlling seasonal variability. The model accounts for less of the observed variability in detritus and dissolved organic matter suggesting the seasonal importance of upland runoff and exchanges with other marsh subsystems in controlling concentrations in tidal creeks. (Author's abstract)
W88-00058

ROLE OF HYDRODYNAMICS IN RECRUITMENT, GROWTH, AND SURVIVAL OF ARGOPECTEN IRRADIANS (L.) AND ANOMIA SIMPLEX (D'ORBIGNY) WITHIN EELGRASS MEADOWS,
Skidaway Inst. of Oceanography, Savannah, GA.
J. E. Eckman.
Journal of Experimental Marine Biology and Ecology, JEMBAM, Vol. 106, No. 2, p 165-191, 1987. 8 fig, 6 tab, 47 ref.

Descriptors: *Mollusks, *Invertebrates, *Shellfish, *Hydrodynamics, Growth, Recruitment, Ecology, Scallops, Bay scallops, Littoral environment, Eelgrass, New York, Sea water.

Larvae of the bay scallop Argopecten irradians (L.) and the common jingle Anomia simplex (D'Orbigny) use byssal threads to settle onto blades of eelgrass Zostera marina (L.) and other elevated substrata. A 2-yr study of the role of hydrodynamics in recruitment of these bivalves into eelgrass meadows, and in their subsequent growth and survival as juveniles, was conducted in Northwest Harbour, New York. Sea-water flux through the meadow varied significantly among sites and depended on the numerical density of eelgrass sprouts. Recruitment of both bivalves varied significantly among sites in a similar manner, indicating that hydrodynamics in eelgrass meadows strongly affects bivalve recruitment. Results from experimental deployments of two types of substrata indicate that hydrodynamics in eelgrass meadows exerts a stronger influence on bivalve recruitment than does either interblade abrasion or possible differences among sites in the nature of the blade substratum. In one of the two study years, hydrodynamics in eelgrass meadows influenced growth and survival of Argopectem following settlement. Abundances and growth of Anomia following settlement appeared unaffected by hydrodynamics. Several lines of evidence suggest that predation is less important than hydrodynamics in determining abundances of recruits and early juvenile stages of these bivalves. (Author's abstract)
W88-00111

LOSS OF COASTAL GRAZING MARSHES IN SOUTH AND EAST ENGLAND, WITH SPECIAL REFERENCE TO EAST ESSEX, ENGLAND,
Royal Society for the Protection of Birds, Sandy (England).
For primary bibliographic entry see Field 4C.
W88-00112

CHEMICAL SURVEY OF THE MISSISSIPPI ESTUARY,
Harvard Univ., Cambridge, MA. Dept. of Earth and Planetary Sciences.
L. E. Fox, F. Lipschultz, L. Kerkhof, and S. C. Wofsy.
Estuaries ESTUDO, Vol. 10, No. 1, p 1-12, March 1987. 12 fig, 2 tab, 28 ref. NSF Grant No. BSR-83-16359, NASA Grant NO. NSG1-55, and EPA Grant R810219-01-0.

Descriptors: *Estuaries, *Path of pollutants, *Fate of pollutants, *Chemical analysis, *Mississippi estuary, Water analysis, Salinity, Hydrogen ion concentration, Inorganic compounds, Nitrogen compounds, Bottom sediments, Chlorophyll a.

A 'snap shot' survey of the Mississippi estuary was made during a period of low river discharge, when the estuarine mixing zone was within the deltaic channels. Concentrations of H(+), Ca(2+), inorganic phosphorus and inorganic carbon suggest that the waters of the river and the low salinity (<5%) portion of the estuary are near saturation with respect to calcite and sedimentary calcium phosphate. An input of oxidized nitrogen species and NO2 was observed in the estuary between 0 and 4% salinity. The concentrations of dissolved NH4(+) and O2, over most of the estuary, appeared to be influenced by decomposition of terrestrial organic matter in bottom sediments. The estuarine bottom also appears to be a source of CH4 which has been suggested to originate from petroleum shipping and refining operations. Estuarine mixing with offshore Gulf waters was the dominant influence on distributions of dissolved species over most of the estuary (i.e., from salinities >5%). The phytoplankton abundance (measured as chlorophyll a) increased as the depth of the mixed layer decreased in a manner consistent with that expected for a light-limited ecosystem. Fluxes of NO3(-) + NO2(-) and soluble inorganic phosphorus to the Gulf of Mexico were estimated to be 3400 plus or minus 200 grams N/second and 1900 plus or minus 200 grams P/second, respectively, at the time of this study. (Author's abstract)
W88-00133

ROLE OF STRATIFICATION IN THE DEOXYGENATION OF MOBILE BAY AND ADJACENT SHELF BOTTOM WATERS,
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
R. E. Turner, W. W. Schroeder, and W. J. Wiseman.
Estuaries ESTUDO, Vol. 10, No. 1, p 13-19, March 1987. 8 fig, 1 tab, 31 ref.

Descriptors: *Oxygen depletion, *Density stratification, *Coastal waters, *Shallow water, *Mobile Bay, Alabama, Bottom water, Stratification, Depletion, Oxygen, Wind velocity.

Oxygen depletion in the shallow bottom waters of Mobile Bay, Alabama, and in adjacent nearshore and continental shelf waters, is directly related to the intensity of water column stratification. Low wind speeds are coincidental with the onset of water stratification and the occurrence of hypoxic events. Hourly, daily, and seasonal changes in the relationship between percent oxygen saturation or oxygen concentration in the bottom waters and surface-bottom density differences indicate that the oxidized materials are recently formed and not relic or overwintering carbon sources. The influence of density structure (water column stratification) in other oxygen-depleted coastal water masses (Chesapeake Bay, coastal Louisiana, and coastal Brittany in France) is compared to Mobile Bay. The slope of the difference in oxygen concentration vs the difference in density in the Chesapeake Bay was three times higher compared to that from similar depths in the Mobile Bay area. The reasons for this difference are not known but may be due to differences in deep water residence time. The slope off the Brittany coast was the same as for the Mobile Bay area. (Wood-PTT)
W88-00134

DEVELOPMENT OF A TIDAL MARSH IN A NEW ENGLAND RIVER VALLEY,
Connecticut Coll., New London. Dept. of Botany.
R. A. Orson, R. S. Warren, and W. A. Niering.
Estuaries ESTUDO, Vol. 10, No. 1, p 20-27, March 1987. 4 fig, 28 ref.

Descriptors: *Tidal marshes, *Salt marshes, *Vegetation establishment, *Vegetation, *New England, Connecticut, Marshes, Salinity, Peat, Estuaries, Estuarine environment, Grasses.

A model for the geomorphic and vegetation development of a river valley tidal marsh in southern New England (Connecticut) is based on both the species composition of roots and rhizomes and on the mineralogic sediments preserved in peat. The maximum depth of salt marsh peat is 3.8 m and in the deepest areas this can overlie up to 1.9 m of fresh to brackish water peat. Based on a radiocarbon date of 3670 plus or minus 140 years before the present (B.P.) for basal peat at a depth of 4.0 m, vertical accretion rates have averaged about 1.1 mm/year. Salt marsh formation began in response to rising sea level 3800-4000 years B.P., as brackish marshes, dominated by bulrush (Scirpus sp.), replaced freshwater wetlands along stream and river channels. Gradually salt marsh vegetation developed over submerging brackish marshes, adjacent uplands, and accreting tidal flats. By 3000 years B.P. the lower estuary was tidal, with sufficient salinity for salt marsh to dominate most wetlands. Spikegrass (Distichlis spicata) was an important early colonizer in salt marsh formation and its role in marsh development has not been documented previously. Blackgrass (Juncus gerardi), currently a typical upper border species, appears in the peat record relatively recently, perhaps within the last few centuries. In contrast, reed (Phragmites australis) has been present for at least 3500 years. The dominance of reed along the upper border today, however, appears to be a relatively recent phenomenon. (Author's abstract)
W88-00135

CONTRIBUTION OF ESTUARIES TO COMMERCIAL FISHERIES IN TEMPERATE WESTERN AUSTRALIA AND THE CONCEPT OF ESTUARINE DEPENDENCE,
Western Australian Marine Research Labs., Perth.
R. C. J. Lenanton, and I. C. Potter.
Estuaries ESTUDO, Vol. 10, No. 1, p 28-35, March 1987. 1 fig, 3 tab, 44 ref.

Descriptors: *Estuaries, *Estuarine fisheries, *Commercial fishing, Sport fishing, Finfish, Fisheries, Western Australia, Crustaceans, Mollusks, Coastal waters, Economic aspects, Fish harvest.

Fisheries catch statistics for temperate Western Australia were considered in conjunction with life cycle data to elucidate the importance of estuaries to the commercial and recreational fisheries in this region. Between 1976 and 1984, 96 species of finfish, 7 species of crustaceans and 12 species of mollusks contributed to the large commercial fishery in estuaries, protected coastal areas and open marine waters of temperate Western Australia. The mean annual weight and monetary value (in 1984 terms) of this fishery was 21,355 tons and 151,300,000 Australian dollars. The contribution of the weight (4,340 tons) and value (3,700,000 Australian dollars) of the estuarine-dependent species to the total fishery was 20.3 and 2.4%, respectively. Estuarine-dependent marine species frequently use protected inshore waters in temperate Western Australia, and have to do so when they occur in subtropical regions in Western Australia where there are no permanent estuaries. Since virtually none of the commercially important marine species in temperate Western Australia can be considered to be entirely dependent on estuaries, and a similar conclusion is valid for many species of marine teleosts found in abundance in estuaries in temperate waters elsewhere in the world, these marine species would best be regarded as estuarine opportunists rather than estuarine dependents. (Author's abstract)
W88-00136

EFFECTS OF GRAZING BY FERAL HORSES, CLIPPING, TRAMPLING, AND BURNING ON A GEORGIA SALT MARSH,
Georgia Univ., Athens. Inst. of Ecology.
M. G. Turner.
Estuaries ESTUDO, Vol. 10, No. 1, p 54-60, March 1987. 5 fig, 3 tab, 37 ref.

Descriptors: *Salt marshes, *Horses, *Marsh plants, *Animal populations, Vegetation, Georgia, Biomass, Primary productivity, Grazing, Cordgrass.

Responses of smooth cordgrass, Spartina alterniflora, marsh to combinations of feral horse grazing, clipping, simulated trampling, and a late winter burn were studied on Cumberland Island National Seashore, Georgia. Replicated 200 sq m plots were established and sampled bimonthly from July 1983 to November 1984. Clipping and trampling each reduced peak aboveground biomass by 20% in 1983 and 50% (clipping) and 55% (trampling) in 1984. A March burn reduced peak aboveground

biomass by 35% in 1984. Trampling and burning each reduced net aboveground primary production (NAPP) by 35%, but clipping did not reduce NAPP. Standing stocks of live rhizomes were correlated with aboveground biomass and were reduced with experimental treatments. Abundance of the periwinkle snail (Littorina irrorata), was also reduced. Horse grazing had a substantial impact on standing stocks and NAPP of Spartina, but grazing was not uniform throughout the marsh. Moderately grazed plots had NAPP reduced by 25% compared to ungrazed plots. Heavily grazed plots had extremely low NAPP, and aboveground Spartina never exceeded 40 g/sq m dry mass compared to 360 g/sq m within enclosures. (Author's abstract)
W88-00139

SAMPLING ZOOPLANKTON IN SHALLOW MARSH AND ESTUARINE HABITATS: GEAR DESCRIPTION AND FIELD TESTS,
Florida Medical Entomology Lab., Vero Beach.
For primary bibliographic entry see Field 7B.
W88-00140

HABITAT SUITABILITY INDEX MODELS: GULF MENHADEN,
Gulf Coast Research Lab., Ocean Springs, MS.
J. Y. Christmas, J. T. McBee, R. S. Waller, and F. C. Sutter.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142513. Price codes: A03 in paper copy, A01 in microfiche. Report FWS/OBS-82/10.23, July 1982. 23 p, 2 fig, 3 tab, 28 ref.

Descriptors: *Habitats, *Fish management, *Menhaden, *Environmental impact statement, Fish, Model studies, Fish populations, Marine fisheries, Coastal waters, Estuaries, Estuarine fisheries, Estuarine environment.

The habitat use information and habitat suitability index (HSI) models presented in this report on the gulf menhaden are intended for use in impact assessment and coastal habitat management. Two models were developed from a review and synthesis of existing data and are scaled to produce an index of habitat suitability between 0.0 (unsuitable habitat) and 1.0 (optimally suitable habitat). Assumptions used to transform habitat use information into the HSI models and guidelines for model applications are described. The estuarine and marine HSI models presented herein are hypotheses of species-habitat relationships, not statements of proven cause and effect relationships. The gulf menhaden is an estuarine-dependent marine species that inhabits northern Gulf of Mexico waters. Gulf menhaden spawn from fall to spring in marine waters. Larval menhaden feed on pelagic zooplankton in marine and estuarine waters. All gulf menhaden life stages are most abundant in salinities ranging from 5 to 10 ppt. The models are designed to evaluate estuarine and nearshore marine habitats of the northern Gulf of Mexico from Texas to Florida. The two HSI models combined are designed for year-round application. The three life requisite variables of the models are water quality, food, and cover. The 14 habitat variables of the models and the relationships between variable values and the suitability of estuarine and marine habitats for gulf menhaden are described. (Geiger-PTT)
W88-00641

SHIP SIMULATION STUDY OF JOHN F. BALDWIN (PHASE II) NAVIGATION CHANNEL, SAN FRANCISCO BAY, CALIFORNIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W88-00823

NORFOLK HARBOR AND CHANNELS DEEPENING STUDY; REPORT 2: SEDIMENTATION INVESTIGATION, CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. C. Berger, S. B. Heltzel, R. F. Athow, D. R. Richards, and M. J. Trawie.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-154978. Price codes: A07 in paper copy, A01 in microfiche. Technical Report HL-83-13, March 1985. Report 2 of a Series. 129 p, 31 fig, 2 tab, 48 plates, 25 ref, append.

Descriptors: *Norfolk Harbor, *Newport News, Virginia, Channels, Model studies, Computer models, Sedimentation, Sediment transport, Channeling.

Because of the increasing demand for deeper draft cargo vessels, the dredging of the approach channels to the harbors of Norfolk, and Newport News, Virginia would be desirable. Prior to these channels modifications, however, a prediction of the possible effects on sedimentation was necessary. The report presents the sedimentation findings from combined physical and numerical model tests (hybrid modeling) of deepening the approach channels to Norfolk and Newport News. The tests included two separate numerical sediment transport models, which were referred to as the Thimble Shoal model and the Elizabeth River model. Based on sedimentation results from the Elizabeth River numerical model, the increase in shoaling caused by the channel deepening as proposed will be 23%. The distribution of shoaled material will not be significantly altered, other than a slight increase in skewness toward the downstream end. Based on sedimentation results from the Thimble Shoal numerical model, the increase in shoaling caused by channel deepening as proposed will be about 20%. The distribution of shoaled material will be slightly altered in that both the upper and lower channel shoaling peaks which presently exist will tend to migrate even more toward the ends of the dredged channel. (Author's abstract)
W88-00828

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 8: SUMMARY REPORT,
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 8B.
W88-00856

ATCHAFALAYA RIVER DELTA, REPORT 10: WAVE HINDCASTS; MAIN TEXT AND APPENDICES A AND B,
Coastal Engineering Research Center, Vicksburg, MS.
R. E. Jensen.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-156693. Price codes: A06 in paper copy, A01 in microfiche. Technical Report HL-82-15, March 1985. Report 10 of a Series. 108 p, 34 fig, 3 tab, 34 ref, 3 append.

Descriptors: *Atchafalaya Bay, *Louisiana, *Shallow water spectral wave modeling, *Wave hindcasting, Wave data, Model studies, Gulf of Mexico, Sediments, Sediment transport, Fetch, Wave growth, Wave action, Wave heights, Waves.

Wind driven water-wave motions in Atchafalaya Bay, Louisiana are thought to provide the energy necessary to place bottom sediments into suspension where they can be transported by currents. Therefore, quantification of the wave climate becomes a critical element in the overall objective of an investigation on predicting the evolution of the bay. A wave-measurement system was deployed for the purpose of determining the wave growth within the bay as a function of fetch length. The program consisted of deployment of pressure-type wave gauges at three sites within the bay. The data thus gathered, plus one year of wind data, were used to develop and verify a wave hindcast model which was used to generate climatological wave information for ten locations in the bay. The information provided by this study is an excellent data base for determining the influence of wave conditions on sediment motion, or other coastal engineering problems, in Atchafalaya Bay. (Halterman-PTT)
W88-00860

REVERIFICATION OF THE CHESAPEAKE BAY MODEL; CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
M. A. Granat, L. F. Gulbrandsen, and V. R. Pankow.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-155486. Price codes: A14 in paper copy, A01 in microfiche. Technical Report HL-85-3, April 1985. Final Report. 288 p, 24 fig, 5 tab, 20 ref, 4 append.

Descriptors: *Chesapeake Bay, *Hydraulic models, *Chesapeake Bay model, *Estuaries, Salinity, Tides, Computer models, Model studies, Salinity currents, Tidal hydraulics.

The entire Chesapeake Bay estuary, from the offshore Atlantic Ocean to the head of the tide for all tributaries, is reproduced by an 8.6 acre fixed-bed model. Because of unusual concrete expansion, repair work was conducted on the model; thus, reverification was required. Data collected on the bay for use in reverification included tides, water velocity, salinity, wind speed and direction, and stream-gauge records. Tide and velocity characteristics were examined under quasi-steady-state conditions associated with a repetitive M2 cosine tide and a constant, long-term average freshwater discharge and distribution. Salinity was examined under more dynamic conditions associated with the reproduction of a 12-tidal constituent, 56-cycle tide and a time-varying 4-year freshwater inflow hydrograph. An induced-mixing bubbler system was used to enhance vertical mixing to reflect salinity structure resulting from wind-associated energy. Excellent model reproductions of tide, velocity, and salinity characteristics were demonstrated. (Halterman-PTT)
W88-00862

ESTUARINE LATERALLY AVERAGE NUMERICAL DYNAMICS: THE DEVELOPMENT AND TESTING OF ESTUARINE BOUNDARY CONDITIONS IN THE LARM CODE,
Edinger (J.E.) Associates, Inc., Wayne, PA.
J. E. Edinger, and E. M. Buchak.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-109712. Price codes: A05 in paper copy, A01 in microfiche. Army Waterways Equipment Station, Vicksburg, MS, Miscellaneous Paper EL-81-9, November 1981. Final Report. 87 p, 23 fig, 4 tab, 27 ref.

Descriptors: *Estuaries, *Model studies, *Hydrodynamics, *Reservoirs, *Saline water, Computer models, Mathematical models, Lakes, Water temperature, Temperature, Stratification, Thermal stratification, Laterally Averaged Reservoir Model, LARM model, Potomac River, LAEM model, Tides, Dispersion coefficients, Wind, Boundary conditions.

The longitudinal and vertical hydrodynamics and transport in stratified waterbodies as formulated for the Corps of Engineers Laterally Averaged Reservoir Model (LARM) have been transformed to estuaries by development of appropriate boundary conditions. The resulting computational code Laterally Averaged Estuary Model (LAEM) is tested on the Potomac River estuary for a short period of time with intensive field data. The estuary problem was formulated in terms of spatially varying geometry, a time-varying tide height and salinity distribution at the mouth, and freshwater inflow. The LAEM code was found to reproduce overall estuarine dynamics including tide heights, tide phase shifts, and salinity distributions. In addition, detailed time-varying vertical velocity profiles were produced to a high degree of resolution. Detailed results of the model including the distribution of vertical velocities and turbulent dispersion coefficients were compared to those expected for a coastal plain estuary with favorable agreement. (Author's abstract)
W88-00865

ELEMENTAL COMPOSITION OF SUSPENDED PARTICULATE MATTER IN THE LOWER

DUWAMISH RIVER AND ELLIOT BAY, WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W88-00876

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

TECHNICAL AND ECONOMIC IMPLICATIONS OF MEASUREMENT AND CONTROL ERRORS IN WATER DESALINATION,
Bechtel National, Inc., San Francisco, CA.
L. Awerbuch, and A. N. Rogers.
Desalination DSLNAH, Vol. 59, p 1-17, August 1986. 8 fig, 3 ref.

Descriptors: *Desalination, *Economic aspects, *Design, *Desalination plants, *Desalination apparatus, *Desalination methods, *Reverse osmosis, *Electrodialysis, *Ion exchange, Temperature effects, Flow rates, Pressure effects, Hydrogen ion concentration, Operating costs, Maintenance costs, Energy consumption.

Dependable control systems are essential for the successful operation of a desalination plant. A well-operated process will prolong plant life, minimize maintenance costs, reduce energy consumption, and achieve the design output of desalted water. Poor process control, on the other hand, will result in scaling, corrosion, and reduced water output. In both thermal and membrane processes, temperatures, pressures, flow rates, and the concentration of additives must be carefully maintained at or near design values. Reliable pH control is essential to minimize corrosion and scale formation. This paper discusses the predominant desalination processes and, for each process, analyzes the influence of deviations in the operating parameters. Where possible, operating limits are indicated. The basic principles outlined are equally applicable to the newer variants of the basic desalination plant designs and to the combination processes now appearing on the market. (Author's abstract)
W88-00086

EXPERIMENTAL METHODS FOR THE DETERMINATION OF THE PROPERTIES OF SALINE WATER,
National Engineering Lab., East Kilbride (Scotland).
For primary bibliographic entry see Field 7B.
W88-00087

MEASUREMENTS AND CONTROL IN FREEZE-DESALINATION PLANTS,
Office of Water Research and Technology, Washington, DC.
W. J. Hahn.
Desalination DSLNAH, Vol. 59, p 321-341, August 1986. 6 fig, 8 ref.

Descriptors: *Desalination plants, *Desalination apparatus, *Process control, *Freeze desalination, Physical properties, Design criteria, Refrigerants, Heat reject systems, Venting systems, Deaerators, Refrigerant strippers, Instrumentation.

The basic flow diagram for the freeze-desalination process is presented and the chemical principles which determine the characteristics of the process equipment employed are described. The functions and design of the major process components (feed precooler, freezer, wash separation column, melter/condenser, primary compressor, and heat reject system) are discussed individually in detail. Variations in equipment design are considered based on the characteristics of the refrigerant selected. The refrigerants considered include water (vacuum freezing) and various hydrocarbons (secondary refrigerant freezing) which are either lighter or heavier than the water to be desalted. An emphasis is placed on process design and the factors which dictate the nature and requirements of the process control system and the characteristics of the instrumentation required to affect adequate control of a commercial desalination plant. Instrumentation and control system diagrams are provided for all equipment items and the variations required by refrigerant selection. (Author's abstract)
W88-00088

MEASUREMENTS AND CONTROL IN REVERSE OSMOSIS DESALINATION,
Permutit Co., Inc., Paramus, NJ.
A. B. Mindler, and A. C. Epstein.
Desalination DSLNAH, Vol. 59, p 343-379, August 1986. 11 fig, 6 tab, 54 ref.

Descriptors: *Reverse osmosis, *Desalination, Design criteria, Scale prevention, Silt density index, Hydrogen ion concentration, Temperature effects, Flow, Conductivity, Water analysis, Process engineering, Chlorine, Oxidation, Instrumentation.

The constraints of reverse osmosis desalination and the techniques and control generally recommended in the design and operation of reverse osmosis systems are discussed. Adequate quality of feedwater to reverse osmosis systems is vital to obtain satisfactory service between cleanings and to obtain maximum membrane life. The controls employed to assure this quality are discussed. Reverse osmosis membranes have constraints in pH, temperature, pressure, flow, and oxidation resistance which are important in the selection and operation. The reverse osmosis system and its design must take into account the analysis of saline water, the service requirements, and the operability of the system. The process engineering of a reverse osmosis system achieves these goals within the guidelines of the membrane manufacturer. Biological constraints of reverse osmosis systems are frequently satisfied by chlorination. However, as some membranes are sensitive even to very low concentrations of oxidant, effective dechlorination and measurement of residual oxidant is necessary. The measurements, instrumentation, and controls employed to assist the operator in meeting the constraints of reverse osmosis desalination are discussed in considerable detail. (Author's abstract)
W88-00089

MEASUREMENTS AND CONTROL RELATED TO CORROSION AND SCALE IN WATER DESALINATION INSTALLATIONS,
Dow Chemical Co., Freeport, TX.
C. F. Schrieber.
Desalination DSLNAH, Vol. 59, p 425-444, August 1986. 4 fig, 8 ref.

Descriptors: *Desalination, *Desalination apparatus, *Corrosion control, *Scale prevention, *Water chemistry, Biofouling, Scaling, Sludge, Fouling, Corrosion, Chlorination, Alkaline scale control, Carbon dioxide, Acid treatment, Deaeration, Brine, Hard scale, Corrosion measurement, Electrical resistance, Linear polarization, Carbon steels, Stainless steel, Copper alloys, Aluminum alloys, Titanium, Plastics, Cements.

Before adequate control can be extended to the corrosion and scaling processes of desalination, it is necessary to define the characteristics of the feedwater. Corrosion presents itself in many forms, but essentially all types of corrosion in desalination installations are electrochemical in nature. From a corrosion and fouling standpoint, proper control of water chemistry associated with chlorination, alkaline scale control, deaeration-dissolved oxygen control and measurement, brine pH control, and hard scale considerations in the desalination process has an overriding influence on plant life. The optimum (minimum) quantities of scale-forming materials needed to make the water innocuous to distribution systems must be established for each plant situation. Corrosion tests such as weight loss significance and real time corrosion monitoring are regularly carried out in combination with process changes to see what effect the environment has on that material. Proper selection of construction materials becomes less of a task if the water chemistry variables are controlled. An overview of satisfactory desalination materials is presented. (Main-PTT)
W88-00090

MEASUREMENT AND CONTROL OF FEED WATER AND PRODUCT WATER COMPOSITION,
Dow Chemical Co., Freeport, TX. Electrochemicals Lab.
W. F. McIlhenny.
Desalination DSLNAH, Vol. 59, p 445-460, August 1986. 8 fig, 1 tab, 22 ref.

Descriptors: *Desalination, *Desalination apparatus, *Desalination wastes, *Feedwater, *Water treatment, *Seawater, *Brine, Drinking water, Guantanamo Bay, Reverse osmosis, Flash distillation, Instrumentation, Flash evaporation.

In a desalting plant, there must be a feed solution to the process, product water must be produced, and a stream containing the rejected components of the feed must be drawn off. These streams are all peripheral to the actual operation of the desalting process, but the treatments, measurements, and control strategies employed with these three streams are of great importance to the success of the desalting operation. The extent of product water quality control depends on the requirements of the most rigorous of the potential end uses. Drinking water quality standards are discussed as are Guantanamo Bay product water treatment and product water instrumentation. It is generally more practical to do all necessary feed water treatments before the desalting operation in correctly sized, instrumented, and operated pretreatment equipment. Each feed water varies in the characteristics that can cause processing problems, and each desalting process varies in sensitivity to the characteristics of the feed waters. Some of these characteristics are discussed. Post plant treatment of the brine is dependent upon the regulatory restrictions on the discharge imposed by the legal jurisdictions at the plant locations. (Main-PTT)
W88-00091

ENERGY ANALYSIS OF MULTI-STAGE DESALINATION PLANTS,
Dal'nevostochnyi Politekhnicheskii Inst., Vladivostok (USSR).
V. N. Slesarenko, and A. S. Shtim.
Desalination DSLNAH, Vol. 61, No. 1, p 1-5, February 1987. 4 fig, 2 tab, 2 ref.

Descriptors: *Desalination, *Multi-stage desalination plants, *Energy analysis, *Energy loss, *Productivity, *Thermodynamic analysis, Heat flow, Temperature effects, Mathematical equations, Theoretical analysis, Evaporation, Flow enthalpy.

The energy method of thermodynamic analysis was applied to a multi-stage desalination plant. It allowed for optimal distribution of parameters within the elements of the thermal scheme. Such distribution substantially reduced energy losses during irreversible processes. It was established by the energy method that the highest amount of energy was lost during the heat exchange process, less energy was lost during separation of seawater into brine and fresh water, and the least energy was lost during hydrodynamic processes. (Author's abstract)
W88-00092

REVERSE OSMOSIS OF WASH WATERS FROM SIMULTANEOUS SO2/NOX WET REMOVAL TECHNIQUE OF FLUE GAS,
Gesamthochschule Essen (Germany, F.R.). Inst. fuer Technische Chemie.
For primary bibliographic entry see Field 5D.
W88-00093

AVOIDING IRON FOULING IN REVERSE OSMOSIS DESALINATION PLANTS,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.

L. E. Applegate, and C. T. Sackinger.
Desalination DSLNAH, Vol. 61, No. 1, p 39-48, February 1987. 1 fig, 1 tab, 32 ref.

Descriptors: *Fouling, *Desalination, *Reverse osmosis, *Iron fouling, *Corrosion, *Desalination apparatus, *Water treatment, Oxidation, Iron, Well water, Brackish water, Bacteria, Seawater, Coagulation, Flocculation, Filtration, Economic aspects, Productivity, Polyvinyl chloride, Plastics, Stainless steel, Steel, Concrete.

Iron fouling of reverse osmosis plants can be prevented by using the proper construction materials and the proper pretreatment. This will result in reduced operating costs, less membrane cleaning, and greater plant utility. The construction materials will prevent corrosion and the formation of iron fouling products. If in some parts of the system, e.g., intake structure, it is not possible to have corrosion resistant materials, the corrosion products can and must be removed from the source water by using the proper pretreatment processes. Once the corrosion products are removed, it is imperative to use corrosion-resistant materials to prevent recontamination of the water before it enters the reverse osmosis devices. (Author's abstract)
W88-00094

SEAWATER DISTILLATION BY SOLAR ENERGY,
Water and Electricity Dept., Abu Dhabi (United Arab Emirates).
A. M. El-Nashar, and A. M. El Baghdadi.
Desalination DSLNAH, Vol. 61, No. 1, p 49-66, February 1987. 14 fig, 1 tab, 5 ref.

Descriptors: *Distillation, *Seawater, *Solar energy, *Desalination, *Solar distillation, *Computer simulation, Plant performance, Feedwater, Meteorological data, Insolation, Absorber plates, Production rates.

Plant performance data obtained from a solar desalination plant during one year of operation were compared with a computer simulation developed for the purpose of predicting the performance of the plant. Data were collected for the monthly average daily insolation on the absorber surface and daily collected heat per square meter of collector area. The experimental and calculated values of the heat collecting system efficiency were compared. The results of the monthly average daily distillate production show that it varied in a manner similar to that of the solar insolation. The distillate production figures generally exceeded what was expected using the simulation program. (Author's abstract)
W88-00095

EFFECT OF WATER DEPTH ON DAILY YIELD OF THE STILL,
Indian Inst. of Tech., New Delhi. Centre of Energy Studies.
G. N. Tiwari, and Madhuri.
Desalination DSLNAH, Vol. 61, No. 1, p 67-75, February 1987. 7 fig, 7 ref.

Descriptors: *Distillation, *Desalination, *Water depth, *Solar distillation, Transient analysis, Mathematical studies, Temperature effects, Theoretical analysis, Solar radiation, Heat transfer, Heat transfer, Heat of vaporization, Still yield.

The effect of water depth on the daily yield of a solar still was studied using transient analysis. An experiment was conducted to verify the theoretical findings using a single basin solar still. It was found that the dependence of yield on water depth is a strong function of initial temperature of the brine in the basin of the still. It was concluded that the daily yield increases with depth of an initial temperature of the brine > or = 45 C and decreases with depth for an initial temperature of the brine > or = 40 C. (Author's abstract)
W88-00096

REVERSE OSMOSIS IN WATER REUSE SYSTEMS,
Utah State Univ., Logan. Div. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W88-00174

WATER STILL WITH A CYCLONE LIQUID-VAPOR SEPARATOR,
Fisons PLC, Ipswich (England).
J. R. R. Shirley-Elgood, G. A. Roulstone, and M. R. Thakker.
U.S. Patent No. 4,622,103; November 11, 1986. 4 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1072, No 2, p 276, November 11, 1986.

Descriptors: *Patents, *Separation techniques, *Stills, *Distilled water, *Vapor compression distillation, *Vaporization, Boiler water, Condensors.

Pyrogen free, low conductivity distilled water is prepared using a still with a cyclone liquid-vapor separator. The still includes lower boiler and upper condensor units for removing droplets from vapor. One of a series of arcuate jets surrounding a capped annulus forces spiralling droplets to unpurge on a deflecting surface on the side wall of the still. A distillate receiver is formed on top of said cyclone liquid/vapor separator with the receiver bottom formed integrally with the top of said capped annulus and with the condensor coil means enabling the vapor separated from the droplets to impinge on the condensor coil to form water collected in the bottom of the distillate receiver. (Cremmins-AEPCO)
W88-00494

SOLAR DESALTING PROCESS,
Aqua-Chem, Inc., Milwaukee, WI.
P. J. Liu.
U.S. Patent No. 4,376, 679; March 15, 1983. 5 p, 1 fig, Official Gazette of the United States Patent Office, Vol 1028, No 3, p 559-560, March 15, 1983.

Descriptors: *Patents, *Desalination, *Seawater, *Solar energy, *Feedwater treatment, *Water treatment, *Solar distillation, Flow rates, Evaporators, Storage tanks, Water storage, Diurnal distribution, Condensation.

Solar energy is used to desalt sea water both during periods of sunshine and at night. A distilling apparatus includes a solar collector having an inlet and an outlet; a storage tank having a capacity greater than that of the solar collector; and a first liquid transfer system for delivering heated liquid from the solar collector to the storage means at a first rate. The system also contains a flash evaporator and a second liquid transfer system connecting the storage tank to the flash evaporator for delivering the stored feed liquid to the flash evaporator at a rate lower than the first one. The flash evaporator is maintained at a temperature lower than the heated feed liquid whereby a portion of the liquid evaporates. A vapor delivery means connects the flash evaporator to the film evaporator for delivering the vaporized portion of the feed liquid from the flash evaporator as the vapor input to a multi-effect evaporator. A third liquid transfer system delivers the unevaporated portion of the feed liquid from the flash evaporator as the liquid input to the multi-effect evaporator; the successive effects of said multi-effect evaporator. The multi-effect evaporator is connected and arranged so that the vapor generated in each effect comprises the heat input to the next succeeding effect whereby successive portions of the feed liquid are evaporated and condensed. The distillate is collected from the last effect as the product of the system. (Cremmins-AEPCO)
W88-00518

MULTIPLE EFFECT THIN FILM DISTILLATION SYSTEM AND PROCESS,
J. P. Petrek, and C. M. Cantrell.
U.S. Patent No. 4,402,793; September 6, 1983. 13 p, 13 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1034, No 1, p 240, September 6, 1983.

Descriptors: *Patents, *Multieffect distillation, *Heat exchangers, *Separation techniques, *Thin films, *Distilled water, Evaporation, Condensation, Alcohols, Hydrocarbons, Potable water, Brackish water, Seawater, Vapor compression distillation, Water treatment, Diffusion.

A multiple effect distillate system includes closely spaced parallel transfer plates defining vapor chambers having opposed evaporating and condensing faces. A heat flux is established across the plates, which are disposed at an angle to the horizontal to enable gravity flow of a liquid along the faces of the plates from an upper edge to a lower edge. Means are provided for feeding and controlling a thin film liquid onto the evaporating face and for removing the separated liquid at the lower end of the plates. The system can be utilized for the separation of liquids having multiple components of different volatility such as alcohol and water, or the various phases of a hydrocarbon such as crude, and for the separation of potable water from brackish and seawater. (Cremmins-AEPCO)
W88-00526

LIQUID PURIFICATION SYSTEM,
F. W. Hoffman.
U.S. Patent No. 4,406,748; September 27, 1983. 16 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1034, No 4, p 1600, September 27, 1983.

Descriptors: *Patents, *Water treatment, *Condensation, *Precipitation, *Seawater, *Ice, *Separation techniques, *Vaporization, *Wastewater treatment, Phase diagrams, Supercooling, Chemical recovery, Water pollution control.

Liquid is purified through the separation of the solvent and solute by an induced phase change. This method is applicable to an aqueous solution of ionizing salts, such as seawater and brackish water. Further applications of the system include sewage treatment, chemical recovery, liquid concentration, and pollution control. During the induced phase change, a portion of the liquid spontaneously vaporizes, thereby removing heat from the remaining liquid and impurities which are allowed to be separated from the vapor. The remaining liquid has a much higher concentration of dissolved impurity and, upon the removal of the heat, becomes supercooled or releases pure solid ice leaving a mixture of concentrated brine and ice crystals. The phase change is accompanied by a sudden reduction in pressure, which may be attained by passing the impure liquid from a region of higher pressure to one of lower pressure. The supercooled liquid is at a lower temperature than the vapor and, therefore, may be utilized within a heat exchanger for condensing the vapor to pure liquid. In a similar manner, the mixture of ice and liquid can be blended with an even more concentrated impure liquid, thus causing the ice to melt and the temperature of the blend to become lower than that of the vapor. (Cremmins-AEPCO)
W88-00527

FORMATION AND REMOVAL OF BROMOFORM DURING DESALINATION,
North Carolina Univ. at Charlotte. Dept. of Environmental Sciences and Engineering.
P. C. Singer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197646/AS. Price codes: A06 in paper copy, A01 in microfiche. Technical Report, August 1982. 96 p, 20 fig, 19 tab, 53 ref, 3 append. Project No. OWRT C-90013-S. Contract No. 14-34-0001-9507 (1).

Descriptors: *Activated carbon, *Reverse osmosis, *Desalination, *Bromoform, *Trihalomethanes, Halogens, Chlorination, Seawater, Cellulose acetate membranes, Chemical analysis, Chloroform identifiers, Pretreatment of water.

A field survey of the desalination pretreatment processes at the U.S. Office of Water Research and Technology's Wrightsville Beach Test Facility showed that bromoform is formed and is the only THM species found when seawater is chlorinated. The bromoform concentration increases through the various pretreatment processes at the Wrights-

ville Beach Test Facility but is removed by the activated carbon columns. Examination of the reverse osmosis membranes in use for desalination at Wrightsville Beach Test Facility showed that certain types of membranes, e.g., cellulose triacetate, do not reject bromoform, while other types, e.g. polyether/urea, do so quite effectively. Adsorption by activated carbon is an effective means of removing bromoform from seawater. The capacity of activated carbon for bromoform is affected by salinity and natural organic substances in seawater. (USGS)
W88-00546

FINAL REPORT ON THE VACUUM FREEZING MULTIPLE PHASE TRANSFORMATION PROCESS INVESTIGATION, (SEPTEMBER 1985 - SEPTEMBER 1986),
Calyxes Research and Development Corp., Albuquerque, NM.
C.-Y. Cheng, and W.-C. Cheng.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-198560/AS. Price codes: A05 in paper copy, A01 in microfiche. Final Report, (1986). 83 p, 32 fig, 10 tab, 2 append. USGS Contract No. 14-08-0001-G1131.

Descriptors: *Desalination processes, *Vacuum freezing, *Vapor liquefaction, Vapor compression distillation, Eutectic freezing, Crystallization, Desublimation, Water vapor.

The Vacuum Freezing Multiple Phase Transformation (VEMPT) Process accomplishes vapor liquefaction by desublimation of the vapor on a refrigerated surface, production of a second water vapor of higher temperature than the melting point of ice, and then directly contacting the second vapor with the desublimate to simultaneously condense the second vapor and melt the desublimate. The second vapor is generated by a thin film evaporator, with the refrigerant vapor generated in the desublimation step, upgraded by a compressor, condensing inside the evaporator. Bench scale experiments with a 3.5% NaCl solution to simulate sea water show that the vapor liquefaction steps can be conducted reliably and at rapid rates; the second vapor can be used to melt ice at rapid rates. Construction of a 5000 gpd unit for conducting the vacuum freezing and vapor liquefaction steps is near completion. It was conceived that the vacuum freezing process could be extended to the treatment of eutectic mixtures to recover solute as well as solvent in a solid or nearly solid form. Preliminary experiments with the water-NaCl system show that co-crystallization of solvent and a dehydrate of the solute as separate crystals can be accomplished, and the substantially lower pressure vapor produced from the eutectic mixture can be liquefied using the VFMPT approach. This approach, in combination with the VFMPT Process which can concentrate a solution to its eutectic composition, would be a most comprehensive method for desalination, industrial solution concentration, water reuse and pollution abatement. An economic analysis based on a conceptual plant was conducted, indicating that the VFMPT plant would be substantially lower in both operating and equipment costs compared with distillation or reverse osmosis processes. (USGS)
W88-00557

GROUND MOISTURE TRANSFER SYSTEM,
L. R. O'Hare.
U.S. Patent No. 4,459,177; July 10, 1984. 11 p, 15 fig. Official Gazette of the United States Patent Office, Vol 1044, No 2, p 757, July 10, 1984.

Descriptors: *Patents, *Solar stills, *Evaporation, *Condensation, *Water vapor, *Moisture, Groundwater, Water cooling, Solar radiation, Convection, Solar energy, Irrigation.

A solar still type system uses heat to evaporate water from damp earth and then condense the water vapor on a cool surface. The damp earth is remote from the area of solar radiation impingement in order to treat water from damp ground deep in the earth. A draft from a solar heated convection column draws air from a solar heater downwards to the subterranean water and then draws the moisture laden air to the surface. As the damp air is drawn back to the surface, it contacts cooled plates near the surface, the water vapor thereby condenses on the plates from which it is collected for irrigation or other purposes. In various embodiments, either vertical or horizontal porous tubes in the ground contact the moist earth to bring the moisture of the earth into contact with the heated air flowing through the tube. (Cremmins-AEPCO)
W88-00562

DISTILLATION APPARATUS WITH A LIQUID-VAPOR SEPARATING DEVICE HAVING THREE CHAMBERS,
J. L. Voorhees.
U.S. Patent No. 4,482,431; November 13, 1984. 5 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1048, No 2, p 743-744, November 13, 1984.

Descriptors: *Patents, *Distillation, *Water treatment, *Domestic water, Distilled water, Drinking water, Separation techniques, Heated water, Cleaning, Vaporization, Baffles, Steel.

A compact, portable distillation apparatus comprises a three-chamber liquid-vapor separating device that is easy to clean. The device can be made of stainless steel to minimize the takeup of impurities in the water and be used domestically by adjustment of the water pressure regulator to compensate for the municipal water pressure. The first chamber receives the water to be distilled and surrounds one end of the second chamber. Liquid from the first chamber passes to a tube located in a second chamber which traverses a path sufficient to heat the water in the tube to a predetermined temperature before exiting through a valve to a liquid/gas separating device. The liquid from the separation device is received in a third chamber, which is provided with a heater to heat the liquid until it vaporizes. It then rises through the second chamber to enter the condenser tube located in the first chamber. The steam entering the condensing tube is cooled by the incoming water and is discharged from the apparatus. (Cremmins-AEPCO)
W88-00563

METHOD AND APPARATUS FOR DISTILLATION,
International Microporous Technology, Inc., Menlo Park, CA.
D. Y. Cheng.
U.S. Patent No. 4,473,473; September 25, 1984. 9 p, 3 fig, Official Gazette of the United States Patent Office, Vol 1046, No 4, p 1638, September 25, 1984.

Descriptors: *Patents, *Desalination, *Evaporation, *Distillation, *Condensation, *Water treatment, *Membranes, Saline water, Seawater, Water vapor, Thermal properties, Porosity, Distilled water.

A composite thermal membrane distillation apparatus, through which evaporation and condensation occur, provides continuous distillate production over prolonged periods. The composite membrane separates a distilland and a distillate, such as a salt water and fresh water. The membrane comprises thin lyophobic microporous and lyophilic layers or membranes. Evaporation and condensation take place within the micropores of the lyophobic membrane. The lyphobic layer prevents intrusion of distilland into the pores of the lyophobic layer. The multiple-layered membrane is not subject to liquid intrusion into the pores of the lyophobic layer with continuous use. (Cremmins-AEPCO)
W88-00564

WOBBLE TUBE EVAPORATOR WITH WHIP ROD FLUID DISTRIBUTOR,
Y. T. Li.
U.S. Patent No. 4,618,399; October 21, 1986. 10 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1071, No 3, p 1193, October 21, 1986.

Descriptors: *Patents, *Evaporation, *Distillation, *Fluid flow, Evaporators, Thin films, Rods, Heat transfer, Heat resistance, Condensation, Tubes.

A wobble tube evaporator or distillation apparatus contains a whip rod that spreads an incoming fluid stream into a very thin, even film. Wobbling thin-walled tubes evaporate the fluid flowing inside the tubes. Heat energy is supplied by condensing the stream of vapor which surrounds the outside surface of the tubes. The condensates that form droplets outside the tubes are thrown off by the wobbling motion and splashed between the tubes to activate further condensation. The wobbling motion of the tube, similar to the circular motion of tea inside a wobbling tea cup, effectively reduces the temperature difference between the vapor outside and inside the tubes. Consequently, less energy or equipment is needed for a given task than with conventional equipment. Vapor and fluid interconnections appropriate to the desired evaporation or distillation system are provided. (Cremmins-AEPCO)
W88-00565

SOLAR DISTRIBUTION APPARATUS,
North American Utility Construction Corp., New York.
V. Stark.
ember 11, 1984. 12 p, 5 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1049, No 2, p 766, December 11, 1984.

Descriptors: *Patents, *Solar distillation, *Desalination, *Seawater, *Distilled water, *Solar energy, Conduits, Water treatment, Condensation, Cooling, Heat transfer.

Liquids, including seawater, are distilled using solar energy and recovery of the released heat of condensation of the condensing liquid in a transparent conduit. The conduit is disposed over the liquid to be distilled. Solar energy passes through the conduit and is received on an undulated plate system over which the liquid to be distilled is conducted. A cooling fluid is circulated through the conduit to adsorb heat released by the condensing liquid. In one embodiment, the conduit does not concentrate the solar energy. The conduit is preferably disposed at an angle of up to about 25 degrees with the horizontal so that the system is subjected to minimal pressure. In another embodiment the conduit defines a fluid lens system which concentrates the solar energy on the plate system. Provision is also made to recover heat from the condensate and a concentrate of the liquid to be distilled. (Cremmins-AEPCO)
W88-00566

AUTOMATED SOLAR STILL,
R. L. Wykoff.
U.S. Patent No. 4,606,794; August 19, 1986. 9 p, 15 fig. Official Gazette of the United States Patent Office, Vol 1069, No 3, p 1209, August 19, 1986.

Descriptors: *Patents, *Solar distillation, *Distilled water, *Solar stills, *Desalination, Evaporation, Heating, Seawater, Water treatment, Solar energy, Pipes, Feedwater treatment.

A solar still comprises a temperature valve within a solar absorber panel. This and other valves and controls halt production when the solar installation is inadequate to support evaporation. The still admits water for treatment only when it requires resupply, operates at nominal pressure by gravity flow, and flushes out suspended and dissolved contaminants automatically. Piping circuitry contains three small ordinary float valves, one manually adjustable turn off valve, and a temperature sensitive valve. Heating occurs either directly in a central chamber or in external panels. Evaporation also occurs either in the central chamber or from trays in an evaporation chamber. The system of controls may be adjusted for use in solar stills for desalinating seawater. (Cremmins-AEPCO)
W88-00567

DISTILLED WATER PRODUCTION DEVICE,
Yamamoto Scientific Co. Ltd., Tokyo (Japan).
For primary bibliographic entry see Field 5F.
W88-00572

DISTILLER AND EVAPORATOR FOR SEA-WATER,
J. Stanisic, and G. Spector.
U.S. Patent No. 4,417,951; November 29, 1983. 4 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1036, No 5, p 1922-1923, November 29, 1983.

Descriptors: *Patents, *Seawater, *Distillation, *Evaporators, *Water treatment, *Desalination, *Condensers, Drinking water, Distilled water, Evaporation, Ships, Water supply, Steam, Baffles.

Seawater is converted to pure fresh water on a large production potential basis through evaporation and distillation. An evaporator with a uniquely designed baffle system is used to separate evaporated steam from non-evaporated water drops. This device is suggested for use aboard a ship having a large amount of waste heat from engine exhaust. The seawater used to cool the engines can be used as a pre-heated saltwater source ready for evaporation. This source, combined with the waste heat from the exhaust gases, can be used in the evaporator device. At least two layers of baffles are placed between the evaporating seawater source and the steam space where the product steam is conveyed to a condenser and water storage tank. The baffles consist of dome shaped sheets having numerous diffuser openings in the shape of venturis. The evaporated steam passing the venturis tends to condense and impinge on the subsequent diffuser plate. The condensate and non-vaporized water drops which impinge on the second baffle plate are carried away to waste. The steam continues through the second series of diffuser nozzles and impinges on the next baffle plate, further separating additional condensate and non-evaporated water drops. The pure steam then moves from the steam space to the condenser. The venturi-shaped diffusers can be equipped with electric contacts so that large water drops entering the nozzle will close an electric circuit and cause a spark which will vaporize the water drops. This modification further reduces the water drop passage into the steam chamber. (Hancuff-AEPCO)
W88-00574

DESALINIZATION APPARATUS,
Mitsubishi Electric Corp., Tokyo (Japan).
H. Kusakawa, and J. Kai.
U.S. Patent No. 4,595,459; June 17, 1986. 10 p, 4 fig, 1 tab. Official Gazette of the United States Patent Office, Vol 1067, No 3, p 1194, June 17, 1986.

Descriptors: *Patents, *Desalination apparatus, *Saline water, *Heated water, *Water treatment, *Latent heat, *Desalination, Water vapor, Condensation, Evaporation, Seawater, Potable water, Irrigation water.

Potable, irrigation, or industrial water is obtained from saline water, such as seawater, through a desalination operation which reduces energy requirements by using the latent heat of condensation of water vapor. The system consists of a section for heating the saline water, a tank for evaporating that water which has passed through the heating section, a tank for condensing water vapor, a pipe for directing the water from the evaporation tank to the condensation tank, together with the carrier gas, and a second pipe to directing the carrier gas to the evaporation tank after it is freed of water vapor which is condensed in the the condensation tank. The need for degasification of the saline water is eliminated. The device is capable of recovering the latent heat of water vapor with high efficiency to achieve an attendant significant increase in the overall heat efficiency. The saline water transferred from the condensation tank to the evaporating tank may be heated by a heat source such as a solar collector, an electrical heater, or a boiler, which makes up for the heat loss due to heat dissipation from the device itself. (Hancuff-AEPCO)
W88-00576

SOLAR DISTILLATION METHODS AND APPARATUS,
M. F. Anderson.
U.S. Patent No. 4,563,248; January 7, 1986. 7 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1062, No 1, p 237, January 7, 1986.

Descriptors: *Patents, *Solar distillation, *Seawater, *Cyclones, *Wave action, *Pumps, Water treatment, Ocean waves, Wind waves, Solar energy, Heating, Evaporation, Condensation, Energy sources.

Solar, wind, and wave energy are used in the distillation of seawater. Wave energy is used to pump ocean water into a collecting basin. The up-and-down motion of the waves is transferred into a pumping energy by placing a float at the surface of the ocean. The rise and fall of the float is then transferred into a pumping action that moves the water into a basin on the land. The basin is covered with a solar energy transmitting cover and as the water evaporates from the surface of the basin, it moves toward a cooling cylinder which passes down through the center of the basin and then horizontally out to the atmosphere. The cooling energy is associated with drawing the cold ocean water into the basin at a low elevation. This air cooling causes a vapor current to move down through the cylinder and condense. A collection trough in the horizontal portion of the cylinder collects the condensate. The third energy source which is recovered in this system is associated with the air currents which move from the basin surface toward and down the central cylinder shaft. The movement of the air in this direction develops a wind current pattern. Due to coriolis acceleration the air enters the inlet conduit to the cylinder with a rotational or cyclonic motion. The air entering the central shaft passes through a wind energy collecting mechanism, thereby allowing for this source of energy to be recovered. (Hancuff-AEPCO)
W88-00578

DESALINATION DEVICE AND PROCESS,
Gore (W.L.) and Associates, Inc., Newark, DE.
W. L. Gore, R. W. Gore, and D. W. Gore.
U.S. Patent No. 4,545,862; October 8, 1985. 13 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1059, No 2, p 772, October 7, 1985.

Descriptors: *Patents, *Desalination apparatus, *Distillation, *Membrane processes, *Seawater, *Vaporization, Water treatment, Vapor, Water vapor, Condensates, Latent heat.

A seawater distillation module consists of a thin, flexible, microporous membrane positioned against an impermeable condenser sheet that bends more stiffly than the membrane. In the process, hot salt water is passed rapidly through the membrane from the hot feed flowing rapidly past it and condenses and collects between and in close contact with the membrane and condenser sheet. The condensed distillate is moved by forces exerted by the hot feed acting on the distillate across the membrane and flows toward a distillate outlet downstream from the hot feed flow. Expanded microporous polytetrafluoroethylene (PTFE) is the preferred membrane material and a spiral wound assembly is the preferred configuration. The flowing distillate gives up its heat to the condenser which in turn is cooled by a rapid flow of salt water on the other side counter to the flows of the hot salt water and the distillate. When this cooled water emerges from the cooling chamber quite warm and, after further heating by an external heater, it is returned to the membrane distillation module to become hot salt water flow. Feed liquid containing a solute (e.g., salt) is distilled while conserving latent heat to achieve high productivity and performance ratios. (Hancuff-AEPCO)
W88-00579

WATER DEGASIFICATION AND DISTILLATION APPARATUS,
For primary bibliographic entry see Field 5F.
W88-00581

HIGH RATE SOLAR STILL AND PROCESS,
C. S. Volland.
U.S. Patent No. 4,613,409; September 23, 1986. 7 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1070, No 4, p 1681, September 23, 1986.

Descriptors: *Patents, *Solar stills, *Distillation, *Heat exchangers, *Evaporators, *Water treatment, Feedwater treatment, Solar energy, Solar distillation, Seawater, Brackish water, Irrigation water, Potable water.

A high rate solar still contains a heat exchanger/evaporator submerged within a salt gradient solar pond with exposed tube sheets. The still configuration reduces ambient heat loss and eliminates pumping of the heating medium. It also rotates to maximize the falling film heat transfer effect, repeatedly expose the concentrate to the heat transfer surface, periodically submerge a large proportion of the heat transfer tubes to reduce scaling, and include flow-through of the heating medium. The still is constructed with a minimum of welds to reduce corrosion. (Cremmins-AEPCO)
W88-00592

PROCESS FOR DISTILLING WATER,
Oriental Metal Mfg. Co., Amagasaki (Japan).
K. Tsumura, and M. Yamashita.
U.S. Patent No. 4,421,606; December 20, 1983. 19 p, 9 fig, 5 tab. Official Gazette of the United States Patent Office, Vol 1037, No. 3, p 1116-1117, December 20, 1983.

Descriptors: *Patents, *Multieffect distillation, *Wastewater treatment, *Seawater, *Groundwater, *Water treatment, *Distilled water, *Desalination, Water cooling, Condensation, Evaporation, Solar distillation.

Wastewater, groundwater and seawater are distilled using a multieffect distillation apparatus. One side of a plate member is heated and water to be treated is evaporated on the other side. The resulting water vapor is condensed on a cooling plate. The apparatus consists of a casing, a heat receiving plate, cooling plates, and a water holder, supply, and collector system. Heat sources include solar heat. (Cremmins-AEPCO)
W88-00593

SYNTHETIC MEMBRANE PROCESSES: FUNDAMENTALS AND WATER APPLICATIONS.
Academic Press, Inc., Orlando, FL, 1984. (Water Pollution: A Series of Monographs). 552 p. Edited by Georges Belfort.

Descriptors: *Membrane processes, *Water treatment, *Hyperfiltration, *Reverse osmosis, *Ultrafiltration, *Electrodialysis, Membranes, Model studies, Wastewater treatment, Desalination, Economic aspects, Filtration.

A series of papers on the use of membrane processes in the fields of water treatment is presented. A summary of some of the latest theoretical developments in membrane and fluid transport is presented and water and wastewater hyperfiltration, ultrafiltration and electrodialysis are reviewed. The topic is generally approached from the standpoint of chemical engineering. As background, the structure of water and aqueous systems is discussed. The major types of membrane systems being used for water renovation and desalination are described, with advantages and applications of each being given. Polarization, mathematical modeling, and plant operation are among the topics included. Economic aspects of these systems are also considered. (See W88-00701 thru W88-00713) (Halterman-PTT)
W88-00700

STRUCTURE OF WATER AND AQUEOUS SYSTEMS,
Marburg Univ. (Germany, F.R.). Fachbereich Physikalische Chemie.
For primary bibliographic entry see Field 1A.
W88-00702

HYPERFILTRATION MEMBRANES, THEIR STABILITY AND LIFE,
Atomic Energy Research Establishment, Harwell (England).
D. C. Sammon.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 73-99, 7 fig, 4 tab, 43 ref.

Descriptors: *Water treatment, *Hyperfiltration, *Membrane processes, Membrane filters, Cellulose acetate membranes, Polyamide membranes, Water, Physical properties, Filtration.

Factors affecting the stability and life of hyperfiltration membranes used in the production of drinking water are discussed. Both cellulose acetate and polyamide membranes are considered. The factors affecting membrane life are feed (chemical constituents and pressure), operating conditions, membrane type, membrane form, plant geometry, and miscellaneous aspects (such as quality of supervision). Since high pressure is inherent in the hyperfiltration process, much research focuses on effects of pressure on membrane structure and on the porous layer. Studies on chemical effects have increased membrane life (to > or = 3 yr) by control of pH to limit hydrolysis (in cellulose acetate), by removal of added chlorine (particularly for polyamides) and by the development of more stable membranes that give adequate salt rejection at lower pressures. Microbiological attack and membrane regeneration are also considered. More work on membrane stability is anticipated as the process is extended to a wide range of effluents and process streams. (See also W88-00700) (Halterman-PTT)
W88-00703

POLARIZATION PHENOMENA IN MEMBRANE PROCESSES,
Technical Univ. of Denmark, Lyngby.
G. Jonsson, and C. E. Boesen.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 101-130, 12 fig.

Descriptors: *Membrane processes, *Water treatment, *Polarization, Water, Reverse osmosis, Ultrafiltration, Electrodialysis, Filtration, Membranes, Model studies.

The phenomenon of polarization with regard to membrane processes (including reverse osmosis, ultrafiltration and electrodialysis) is discussed. The polarization phenomenon reduces the separation efficiency. With increasing polarization, the flux of the more permeable solute decreases and the flux of the less permeable solute increases. The film-theory model used to desribe polarization is presented, as are equations for the measurement of concentration polarization. The role of polarization in fouling of membranes is considered, and the fouling mechanism is described. Methods for preventing fouling (including pretreatment of the feed solution) and for cleaning membranes are discussed. Other effects of polarization ('water-splitting' and poisoning) are presented. (See also W88-00700) (Halterman-PTT)
W88-00704

MATHEMATICAL MODELING OF FLUID FLOW AND SOLUTE DISTRIBUTION IN PRESSURE-DRIVEN MEMBRANE MODULES,
Rensselaer Polytechnic Inst., Troy, NY.
C. Kleinstreuer, and G. Belfort.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 131-190, 17 fig, 4 tab, 166 ref.

Descriptors: *Membrane processes, *Model studies, *Water treatment, Hyperfiltration, Electrodialysis, Ultrafiltration, Membranes, Filtration, Mathematical models.

An updated review of the critical fluid engineering problems associated with mass-transfer membrane processes (electrodialysis, hyperfiltration, and ultrafiltration) are presented. Mathematical models are used to produce solutions, and the effects of the solutions with respect to maximizing the performance/cost ratio are considered. Schematics for common membrane elements are given as background. The general modeling approach and field equations are discussed, and mass-transfer submodels and fluid flow submodels are described in detail. Case studies illustrating the application of these models are presented. The case studies involve solving problems regarding hollow fiber reverse osmosis systems, straight conduit ultrafiltration systems, and reduction of polarization layers. Problems with the existing models are considered and suggestions are made for future research. (See also W88-00700) (Halterman-PTT)
W88-00705

ELECTRODIALYSIS - MEMBRANES AND MASS TRANSPORT,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Applied Research Inst.
E. Korngold.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 191-220, 2 fig, 4 tab, 53 ref.

Descriptors: *Membrane processes, *Dialysis, *Electro-osmosis, *Electro dialysis, Water treatment, Membranes, Permselective, Hyperfiltration.

Electrodialysis, based on the electromigration of ions through cation- or anion-exchange permselective membranes that permit the passage of positive or negative ions, respectively, is discussed. The focus of the discussion is membranes and mass transport. Specific topics included are mass transfer through permselective membranes, manufacture of permselective membranes, membrane permselectivity, diffusion, water transport through permselective membranes (by electroosmosis and osmosis), electrotransport of large ions through permselective membranes, energy and membrane area requirements, and resin-filled cells. (See also W88-00700) (Halterman-PTT)
W88-00706

DESALTING EXPERIENCE BY HYPERFILTRATION (REVERSE OSMOSIS) IN THE UNITED STATES,
Rensselaer Polytechnic Inst., Troy, NY.
G. Belfort.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 221-280, 9 fig, 8 tab, 175 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Hyperfiltration, Membranes, Membrane processes, Desalination, Desalination apparatus, Municipal wastewater, Industrial wastewater.

The hyperfiltration desalting experience in the United States is discussed. Emphasis is on developments in new-membrane-polymer characteristics, elementary theoretical transport considerations, and plant equipment including membrane permeator design. The primary feature of this discussion is a review of the hyperfiltration (or reverse osmosis) process applications, including water desalination, industrial and municipal wastewater applications, and treatment of polluted rivers. The control of product flux decline is discussed, along with the important and complementary role of pretreatment and membrane cleaning methods. (See also W88-00700) (Halterman-PTT)
W88-00707

DESALTING EXPERIENCE USING HYPERFILTRATION IN EUROPE AND JAPAN,
Gesamthochschule Essen (Germany, F.R.).
E. Staude.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 281-341, 16 fig, 20 tab, 114 ref.

Descriptors: *Hyperfiltration, *Membrane processes, *Membranes, Water treatment, Desalination, Economic aspects, Wastewater renovation, Wastewater treatment, Food processing industry.

The very wide variety for hyperfiltration in Europe and Japan is discussed. Some of the areas where hyperfiltration is used include seawater desalination, hyperfiltration of brackish water, hyperfiltration in industry and food production (alcohol-containing beverages, concentration of fruit juices, dairy products, and carbohydrates). Wastewater renovation by hyperfiltration is also discussed. The fact that this process has not reached large scale technical application is discussed. Possible reasons for this may include the need for better membranes, higher permeation flux and rejection, and a longer lifetime. Economic reasons, related to the relatively high investment costs associated with hyperfiltration plants, are also considered. (See also W88-00700) (Halterman-PTT)
W88-00708

WATER AND WASTEWATER TREATMENT EXPERIENCE IN EUROPE AND JAPAN USING ULTRAFILTRATION,
Fraunhofer-Inst. fuer Grenzflaechen- und Bioverfahrenstechnik, Stuttgart (Germany, F.R.).
H. Strathmann.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 343-375, 10 fig, 5 tab, 69 ref.

Descriptors: *Ultrafiltration, *Membrane processes, Membranes, Water treatment, Wastewater treatment, Food processing industry, Japan, Europe, Economic aspects.

Various aspects of ultrafiltration technology are discussed. The membranes currently used in ultrafiltration are composed of cellulose acetate, polysulfone, polyamide, and polyacrylonitrile. The modules and system designs used in ultrafiltration processes include tubular membrane, plate and frame membrane, spiral-wound membrane, capillary membrane, and the rod membrane. A comparison of these modules indicates that no one module design dominates the field because each system seems to have found its own area of application. Practical experiences in ultrafiltration in advanced wastewater and process water treatment systems, food processing and the chemical industry, are presented. Process costs and distributors of equipment in Europe and Japan are listed. (See also W88-00700) (Halterman-PTT)
W88-00709

DESIGN, OPERATION, AND MAINTENANCE OF A 5-MGD WASTEWATER RECLAMATION REVERSE OSMOSIS PLANT,
For primary bibliographic entry see Field 5D.
W88-00710

DESIGN AND OPERATION OF DESALTING SYSTEMS BASED ON MEMBRANE PROCESSES,
Bechtel Corp., San Francisco, CA.
A. N. Rogers.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 437-477, 11 fig, 14 ref.

Descriptors: *Membrane processes, *Hyperfiltration, *Ultrafiltration, *Dialysis, Membranes, Desalination, Municipal wastewater, Economic aspects, Water treatment.

Membrane treatment plants of various types, the pretreatment of feed streams to the plants, and the post-treatment of the purified water are discussed. The various types of membrane treatment plants include reverse osmosis, electrodialysis, and ultrafiltration. The purchasing specifications, process details, cleaning of the membranes and plant maintenance are discussed for each of these types of membrane treatment plants. Pretreatment of wastewater includes softening by ion exchange, lime and lime-soda softening, removal of iron and manganese, filtration, chlorination and chlorine removal, pH control, calcium sulfate control, and cartidge filters. Post-treatment includes decarbonation, silica removal and pH adjustment. (See also W88-00711) (Halterman-PTT)
W88-00711

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

ECONOMICS OF THE APPLICATION OF MEMBRANE PROCESSES; PART I: DESALTING BRACKISH AND SEAWATERS,
Mekoroth Water Co., Tel-Aviv (Israel).
P. Glueckstern, and N. Arad.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 479-507, 8 fig, 9 tab, 22 ref.

Descriptors: *Membrane processes, *Water treatment, *Desalination, Membranes, Demineralization, Filtration, Economic aspects, Ultrafiltration.

The cost of desalted water is determined by a large number of factors, such as site, process technology, plant capacity, and economic parameters. Wherever brackish water is available, membrane processes are currently more economical than thermal desalting processes, even when coupled to a power station and utilizing low-grade heat. For seawater desalting, reverse osmosis plants are in many cases competitive with distillation processes, especially for small plants at locations with prevailing high energy costs; however, no general conclusions can be made without a detailed investigation for any specific application. The enormous potential of membrane processes for long-term desalting of all kinds of saline waters is discussed. (See also W88-00700) (Halterman-PTT)
W88-00712

OXIDATION OF FORMALDEHYDE SOLUTIONS USED FOR THE PRESERVATION OF REVERSE OSMOSIS MEMBRANES,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. J. Boegli, A. P. Murphy, and M. K. Price.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-185585. Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-84-8, December 1984. 57 p, 24 fig, 7 tab, 12 ref, 9 append.

Descriptors: *Desalination, *Cellulose acetate membranes, *Wastewater treatment, *Desalination plants, *Oxidation, Reverse osmosis, Membranes, Chemical treatment, Membrane processes, Desalination wastes, Industrial wastewater.

Results of an experimental study of a new process for the catalytic oxidation, at ambient temperatures, of dilute formaldehyde used in aqueous solutions for the preservation of cellulose acetate reverse osmosis membranes are presented. The oxidation involves hydrogen peroxide and an iron (ferric chloride) catalyst and was initially tested in a bench-scale adiabatic reactor to develop operating curves for several concentrations of formaldehyde and to show the total oxidation time as a function of solution temperature, reactant concentration, stirring rate, and the type of purge gas used. A subsequent series of tests generated isothermal data for fitting a temperature and concentration-dependent rate equation. The reaction, which proceeds by formic acid production, was shown to be effective in completely oxidizing formaldehyde solutions at concentrations at, or greater than 250 mg/L to carbon dioxide and water (with formaldehyde vapor detected in the products gas stream at <0.4 mg/cu m). The oxidation was rate-dependent rather than diffusion controlled, and based on chemical similitude considerations, can be scaled up directly. Based on study results, recommendations are made for the design and operation of a full-scale reactor for the Yuma Desalting Plant. An estimate is provided for the cost of chemicals used in oxidizing a single flushing from a control block (45,000 liter) at an assumed concentration of 1200 mg/l. (Geiger-PTT)
W88-00776

CATION-EXCHANGE PRETREATMENT STUDIES FOR LAVERKIN SPRINGS,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
J. W. Kaakinen.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-173508. Price codes: A13 in paper copy, A01 in microfiche. Report REC-ERC-84-12, August 1984. 284 p, 11 fig, 10 tab, 33 ref, 8 append.

Descriptors: *Desalination plants, *Water treatment, *Cooling water, *Water softening, Ion exchange, Electrodialysis, Reverse osmosis, Scaling, Calcium sulfate, Gypsum, Cation exchange, Cooling towers, La Verkin Springs, Membrane processes, Brines, Brine disposal, Desalination wastes, Industrial wastes, Saline water, Resins, Demineralization.

The main purpose of the cation-exchange experiments on La Verkin Springs (LVS) water was to obtain feasibility data for the pretreatment removal of calcium from desalting feed water or cooling tower makeup water to prevent gypsum-scale formation when achieving high rates of water use. In field tests at the LVS site, a 30-liter/min-capacity ion exchange pilot plant softened the feed water to (and thus prevented gypsum scaling in) an electrodialyzer at desalting recoveries of up to 92%. Special techniques were needed to prevent gypsum-scale accumulation in the ion exchange system: (1) the use of recycled regenerant preceding fresh reject-brine regenerant to lower the level of calcium sulfate supersaturation, and (2) high regeneration flow rates and a packed resin bed to minimize the residence time of regenerant in the resin bed. Laboratory ion exchange experiments simulating LVS conditions provided data which agree with field test results but extend the number and ranges of the process variables to better characterize the ion exchange process. Results showed the $>90\%$ product-water-recovery rates from desalination plants could be attained while minimizing the brine disposal waste stream. It was possible to use saline water as makeup to cooling towers while minimizing the brine disposal volume. Pretreatment costs were reduced compared with lime soda softening. (Cassar-PTT)
W88-00777

SOUTHWEST REGION SOLAR POND STUDY FOR THREE SITES - TULAROSA BASIN, MALAGA BEND, AND CANADIAN RIVER,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. J. Boegli, M. M. Dahl, and H. E. Remmers.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-186211. Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-83-17, August 1984. 77 p, 29 fig, 18 tab, 48 ref, 3 append.

Descriptors: *Cost analysis, *Electric power production, *Hydroelectric power, *Reclaimed water, *Desalination, Electric power, Economic aspects, Saline water, Salinity, Solar energy, Thermal power, Desalination plants, Distillation, Fuel.

The Bureau of Reclamation investigated the technical and economic feasibility of using solar salt-gradient ponds to generate power and to produce freshwater in Bureau projects at three sites - the Canadian River at Logan, New Mexico; Malaga Bend on the Pecos River near Carlsbad, New Mexico; and the Tularosa Basin in the vicinity of Alamogordo, New Mexico. The ponds would be used to generate electric power that could be integrated with the Bureau's power grid or used in combination with thermal energy from the ponds to power commercially available desalination systems to produce freshwater. Results of the economic analysis, which concentrated primarily on the Tularosa Basin site, showed that solar-pond-generated intermediate load power would cost between 62 and 90 mills/kWh and between 52 and 83 mills/kWh for baseload power. This results in benefit-cost ratios of approximately 2.0 and 1.3 for intermediate and baseload, respectively, when compared to similar facilities powered by fossil fuels. The cost savings are even more pronounced when comparing the two (solar versus fossil fuel) as a source of power for conventional distillation and membrane-type desalination systems. (Author's abstract)
W88-00781

POTENTIAL CONSEQUENCES OF REJECT STREAM REPLACEMENT PROJECTS ON AQUATIC, TERRESTRIAL, AND RECREATION RESOURCES: VOLUME I, STUDY INTRODUCTION AND DESCRIPTION OF CANDIDATE PROJECTS.
Engineering-Science, Inc., Arcadia, CA.
Water and Power Resources Service, Boulder City, NV. February 1980. 56 p, 22 fig, 7 tab.

Descriptors: *Water conservation, *Water reuse, *Desalination plants, Diversion, Yuma Desalting Plant, Arizona, Canals, All-American Canal, Reclaimed water, Geothermal studies, Canal linings, Linings, Water loss, Alamo River, Colorado River, East Highline Canal, Butler Valley, Brines, Water transfer, Conservation.

Six candidate projects for replacing 42,000 acre-feet/year of reject stream water at the Yuma Desalting Plant, Arizona, are described. Also included are the background, objective, and approach of the study. Each of the projects would produce and additional flow of 42,000 acre-feet/year in the Colorado River as it enters Mexico. Results of the study are presented in a separate volume. The projects are as follows: CP-1, reconstruction of 30 miles of the All-American Canal to reduce water loss; CP-2, reclamation of Alamo River water and discharge into the East Highline Canal for use as irrigation water; CP-3, desalination of geothermal fluid at the East Mesa Geothermal Test Site and release into the All-American Canal; CP-4, groundwater pumping south of the All-American Canal to intercept seepage water from the canal; CP-5, groundwater pumping in Butler Valley, Arizona, in land owned by the Bureau of Land Management; and CP-6, increase of water recovery efficiency in the Yuma plant so that only 24,000 acre-feet/year of replacement water is required. Since plant CP-6 replaces only a portion of the total amount of water, it would have to be combined with a portion of one of the other candidate amounts. (Cassar-PTT)
W88-00813

3B. Water Yield Improvement

STOCHASTIC CONSIDERATIONS IN OPTIMAL DESIGN OF A MICROCATCHMENT LAYOUT OF RUNOFF WATER HARVESTING,
Ben-Gurion Univ. of the Negev, Beersheva (Israel). Dept. of Industrial and Management Engineering.
G. Oron, and G. Enthoven.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1131-1138, July 1987. 10 fig, 1 tab, 18 ref.

Descriptors: *Runoff harvesting, *Water harvesting, *Water supply, *Management models, *Model studies, *Data interpretation, *Arid zones, Microcatchment design, Catchment areas, Design criteria, Water use, Rainfall-runoff relationships, Arid climates, Arid lands.

A management model was defined and solved for optimal runoff water use in arid zones via microcatchment. The microcatchment (MC) layout consists of hexagons. In determining their optimal size, stochastic characteristics of the rain and runoff generation were taken into account. The purpose of the management model was to maximize the profit per unit of MC cultivated layout area wetted with runoff water over the period which was in the range of 10-15 years and equal to the life span of the MC. Results indicated that the optimal size of the hexagon in an MC layout with a tree in the center of each MC was in the range of 100-200 sq m. (Wood-PTT)
W88-00024

MICROPHYSICAL AND RADAR OBSERVATIONS OF SEEDED AND NONSEEDED CONTINENTAL CUMULUS CLOUDS,
Weather Bureau, Bethlehem (South Africa).
For primary bibliographic entry see Field 2B.
W88-00146

HEADWATERS VIEW OF CLOUDSEEDING IN THE COLORADO RIVER BASIN,
Colorado Dept. of Natural Resources, Denver.
For primary bibliographic entry see Field 6E.
W88-00349

POTENTIAL ECOLOGICAL IMPACTS OF SNOWPACK AUGMENTATION IN THE UINTA MOUNTAINS, UTAH,
Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
For primary bibliographic entry see Field 6G.
W88-00350

SIMULATED IMPACT OF WEATHER MODIFICATION ON THE COLORADO RIVER,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
J. C. Lease.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 233-247, 4 fig, 4 tab, 8 ref.

Descriptors: *Artificial precipitation, *Weather modification, *Cloud seeding, *Water supply, Colorado River, Streamflow, Model studies, Snowpack, Runoff, Salinity, Mexico, International agreements, Reservoirs, Lake Powell, Lake Mead, Hydroelectric power, Electric power production, Water storage, Economic aspects.

Weather modification is a viable method for augmenting the flow of the Colorado River. Simulation, using historic meteorological and hydrological data as input to the Colorado River Simulation System model, indicates that streamflow can be increased by an average of over 14%, or 1600 million cu m (1.3 million acre-ft) over a 30-year period. Furthermore, the value of this additional water totals approximately $80 million annually for the following sources: $29 million from increased hydroelectric power production, $40 million from salinity reduction, $5.5 million from water supplies to reduce deficits in Arizona and California, and $5 million from water available for new uses. (See also W86-02484) (Author's abstract)
W88-00351

ENVIRONMENTAL AND SOCIAL IMPLICATIONS OF CLOUD SEEDING IN THE COLORADO RIVER BASIN,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
For primary bibliographic entry see Field 6G.
W88-00352

USE OF HYDROELECTRIC DAMS TO CONTROL EVAPORATION AND SALINITY IN THE COLORADO RIVER SYSTEM,
Nevada Univ., Las Vegas.
L. J. Paulson.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 439-456, 7 fig, 2 tab, 17 ref.

Descriptors: *Water conservation, *Water quality control, *Evaporation control, *Water loss, *Reservoir operation, *Hydroelectric plants, *Salinity, Colorado River, Lake Mead, Lake Powell, Glen Canyon Dam, Hoover Dam, Intakes, Temperature, Water temperature.

Hydroelectric facilities can be operated to reduce evaporation and improve water quality in the Colorado River system. Cold-water discharges from Glen Canyon Dam (Lake Powell) during a 1977-1978 study contributed only 9.04 cal/sq cm-day of heat to downstream Lake Mead, compared with 300-400 cal/sq cm-day (pre-Lake Powell) during the summer months. Pre- and post Lake Powell evaporation rates averaged 85.2 inches/year and 76.8 inches/year, respectively, equivalent to a reduction in annual water loss of at least 120 million cu m. If Glen Canyon Dam were operated with deep discharge and Hoover Dam (Lake Mead) were shifted to a surface discharge, the combined plan would result in evaporation loss reduction of 263 million cu m/year. In addition, this combined discharge plan would reduce salinity levels in Lake Mead by 16 mg/L (9 mg/L with Glen Canyon deep water discharge and Hoover Dam deep discharge). Possible problems associated with warmwater discharges from Lake Mead include modification of the intake structures, impact on the downstream cold water fisheries, increased evaporation from Lake Mohave and Lake Havasu, and alteration of Lake Mead's nutrient budget (increased nitrogen retention of 66% and increased phosphorus retention of 60%). (See also W86-02484) (Cassar-PTT)
W88-00359

METHOD OF PROVIDING EARTH COVERING USEFUL FOR WATER HARVESTING,
Dow Corning Corp., Midland, MI.
S. A. Brady, and M. G. Elias.
U.S. Patent No. 4,405,264; September 20, 1983. 13 p, 13 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1034, No 3, p 1093-1094, September 20, 1983.

Descriptors: *Patents, *Water harvesting, *Impervious membranes, *Silicon, *Elastomers, *Earth-water interfaces, *Water supplies, Water transport, Depression storage, Coatings, Materials engineering.

A reinforced elastomeric silicone membrane or cloth, impervious to liquid water, lines the surface of a depression so as to direct, transport or hold water. The coated cloth is bonded at the seams and the perimeter of the cloth is stabilized. The method yields a structure that is economical to manufacture, yet has a long, useful life in such applications as catchments, irrigation ditches, and holding ponds. (Cremmins-AEPCO)
W88-00521

WATER HARVESTING AND STORAGE SYSTEM,
V. Bucherre.
U.S. Patent No. 4,527,927; July 9, 1985. 7 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1056, No 2, p 727-728, July 9, 1985.

Descriptors: *Patents, *Water harvesting, *Water supplies, *Water storage, *Rain, Reservoir storage, Catchment areas, Potable water, Water distribution, Pumped storage, Gravity flow, Livestock, Domestic water, Irrigation water, Storage tanks, Membranes.

Rain is collected and stored in a catchment for human consumption, livestock, domestic use, or irrigation. System components comprise a water impervious membrane or sheet for forming the catchment; one or more flexible storage tanks; at least one pump; a suitable strainer; and incidental piping and couplers. The sheet or membrane is secured over the prepared catchment surface and the piping is connected between the catchment, storage tank(s), and pump(s). (Cremmins-AEPCO)
W88-00584

VALUE OF ELECTRIC POWER AND POSSIBLE EFFECTS OF WEATHER MODIFICATION ON SMALL-SCALE HYDROELECTRIC PRODUCTION IN COLORADO,
Colorado Dept. of Natural Resources, Denver.
W. Loehr, B. C. Welles, and L. A. Sherretz.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-181386. Price codes: A04 in paper copy, A01 in microfiche. Bureau of Reclamation, Denver, CO., Dir of Atmospheric Resources Research. November 1983. 46 p, 2 fig, 13 tab, 2 append.

Descriptors: *Hydroelectric power, *Electric power production, *Weather modification, *Cloud seeding, *Streamflow, Hydroelectric plants, Electric power, Artificial precipitation, Artificial storms, Energy, Value.

The value of electric power in Colorado and the effects of possible increases in streamflow resulting from cloud seeding on the production of small-scale hydroelectric power in Colorado were examined. It was demonstrated that the value of power in Colorado ranges between about 1.4 and 12.0 cents per kilowatt hour, depending on the circumstances in which the energy is produced and used. Possible effects of cloud seeding on streamflow were determined by relating flow at proposed small-scale hydroelectric sites near Telluride and at Reudi Reservoir to April 30 snow water equivalents. At the Telluride site a 15% increase in April 30 snow water equivalent increased electric energy output by 3.5% and raised the value of energy output by 5.0%. At the Reudi site a 15% snow water equivalent increase raised energy output by 6.1% and its value by 9.9%. It was concluded that possible increases in streamflow from cloud seeding could increase significantly the amount and value of the energy output from small-scale hydropower facilities in Colorado. (Geiger-PTT)
W88-00783

HIPLEX: A COOPERATIVE PROGRAM ON RAIN AUGMENTATION IN THE HIGH PLAINS,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
A. S. Dennis, E. W. Holroyd, W. E. Howell, D. A. Matthews, and B. A. Silverman.
June 1984. 55 p, 15 fig, 9 tab, 305 ref.

Descriptors: *Cloud seeding, *Artificial precipitation, *Crop production, *Water yield improvement, *Cost-benefit analysis, Precipitation, Models, Crop yield, Environmental effects, Rainfall, Economic aspects, Weather modification, Water supply development, Water resources development, Benefits.

The HIPLEX (High Plains Cooperative Program) was a cooperative effort of several federal and local agencies and the Canadian government to reduce scientific uncertainties associated with attempts to increase growing season rainfall in the High Plains by seeding summer convective clouds. HIPLEX involved a number of field projects as well as supporting studies in short-range forecasting, cloud modeling, forage and crop yields, agricultural economics, and environmental matters. A randomized experiment (HIPLEX-1) was conducted on isolated cumulus congestus clouds around Miles City 1979-1980 to document the steps in a physical hypotheses linking dry ice seeding of small to moderate sized cumulus clouds to increased rainfall at cloud base. Results showed that liquid water concentrations decreased so rapidly in test clouds that graupel could not grow to precipitation size. It is recommended that seeding trials proceed in larger clouds. Studies of the value of additional precipitation from cloud seeding projects suggest that the net benefits of the HIPLEX project justify continued experimentation to develop an effective precipitation enhancement technology. (Geiger-PTT)
W88-00788

FINAL REPORT ON THE CONTINUING DESIGN, REVIEW, AND ANALYSIS WORK FOR THE SIERRA COOPERATIVE PILOT PROJECT,
North American Weather Consultants, Salt Lake City, UT.
R. D. Elliott, D. A. Griffith, J. A. Flueck, and J. F. Hannaford.
Report No. SLWM-84-2, November 1984. 209 p, 93 fig, 23 tab, 40 ref, append.

Descriptors: *Weather modification, *Cloud seeding, *Artificial precipitation, *Artificial storms, *Evaluations, Precipitation, Orographic precipitation, Models, Design criteria, Statistical analysis, Weather data collections, Data interpretations.

This report covers events relevant to the work conducted by North America Weather Consultants (NAWC) under its contract to the Bureau of Reclamation, on the Sierra Cooperative Pilot Project (SCPP). Summaries of the work performed each year from 1977 to 1984 are given. The SCPP is an on-going winter weather modification research program being conducted in the central Sierra Nevada of California. NAWC's objectives in the performance of this work were threefold: to complete the physical and statistical design of the

SCPP, to review the project during its lifetime to insure that operations comply with the design, and to perform an unbiased evaluation of the cloud seeding results. The major chapter headings in this report summarize the broad range of the types of work performed: hydrology and suspension criteria; SCPP experimental area, extended areas of effect and contamination questions; continuing evolution of precipitation echo types; continuing evolution of conceptual models; quantitative models; statistical and data analysis work; and review and reporting functions. (Geiger-PTT)
W88-00875

3C. Use Of Water Of Impaired Quality

IRRIGATION CONTROL IN THE PRESENCE OF SALINITY: EXTENDED LINEAR QUADRATIC APPROACH,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Bras, and D.-J. Seo.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1153-1161, July 1987. 10 fig, 23 ref. NSF Grant 78-20245ENG.

Descriptors: *Water quality control, *Saline water, *Path of pollutants, *Irrigation practices, *Extended Linear Quadratic method, *Model studies, *Salinity, Irrigation, Mathematical equations, Nonlinear programming, Irrigation water, Water allocation, Salt movement, Root zone, Transpiration, Salt accumulation, Moisture stress, Corn, Colorado.

When damaging salinity is present in the root zone or use of saline irrigation water is inevitable, irrigation scheduling must be such that not only high agricultural productivity is maintained, but also salt accumulation in the root zone is avoided. An intraseasonal irrigation scheduling problem is dealt with via extended linear quadratic (ELQ) control. The ELQ control is well-suited for constrained multidimensional problems and provides open-loop feedback control rules over the control horizon. A conceptual model was developed to describe the dynamics of water allocation and salt movement in the root zone of a crop. Moisture stress and osmotic stress are combined to obtain the integrated inhibitory effect of salinity on transpiration. For the intraseasonal model to be effective against perennial salt accumulation in the root zone, it should be able to yield control laws which will lead to favorable root zone conditions at the end of an irrigating season. This long-term aspect of salinity control is handled via probabilistic state constraints which impose desired salinity and moisture levels with desired confidence level. The ELQ control was employed in a case study of expected net benefit maximization over an irrigation season of corn in Fort Morgan, Colorado. The results, in general, correspond well with expected irrigation schedules under different conditions and provide valuable information on both short- and long-term aspects of irrigation control under saline conditions. The ELQ control, being an analytic iterative solution scheme with theoretically guaranteed fast convergence, has a distinct computational advantage over state-of-the-art procedures. (Author's abstract)
W88-00027

PLANT GROWTH FACTORS IN MUNICIPAL WASTEWATER,
Arizona Univ., Tucson. Dept. of Plant Sciences.
F. R. H. Katterman, and A. D. Day.
BioCycle BCYCDK, Vol. 28, No. 5, p 62-63. 1 fig, 1 tab, 10 ref.

Descriptors: *Water reuse, *Plant growth factors, *Municipal wastewater, *Wastewater use, *Fertilizers, *Cytokinin, *Growth factors, Irrigation water, Soybean callus, Growth assay, Biochemistry, Bioassays, Chromatography.

In addition to containing considerable quantities of principal fertilizer elements, treated municipal wastewater also has a cytokinin-like growth factor. Both research and field projects have shown that municipal wastewater (MWW) can be successfully used as a source of irrigation water. Aside from the ureido-adenosine type previously described there is another cytokinin-like fraction of much greater activity present in MWW. The isolation and tentative nature of this highly active component from MWW is described. Four liters of MWW were prepared for analysis by the soybean callus growth bioassay. The callus tissue in each fraction was weighed and plotted as a function of fraction number. The relative biological potency among the eluted fractions were compared by means of the soybean callus assay. Two areas of callus growth, detected by chromatography, were significantly higher than the overall average growth of callus. A comparison of cytokinin activity in several fractions, in terms of specific activity, indicated that the second area of cytokinin activity was 12 times more active than the first area. (Main-PTT)
W88-00085

EFFECTS OF FERTILIZER FACTORY EFFLUENT ON SOIL AND CROP PRODUCTIVITY,
D.A.V. Coll., Muzaffarnagar (India). Dept. of Botany.
K. K. Singh, and L. C. Mishra.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 3/4, p 309-320, April 1987. 1 fig, 7 tab, 24 ref.

Descriptors: *Water reuse, *Wastewater irrigation, *Fertilizers, Industrial wastewaters, *Soil, *Crop productivity, Corn, Rice, Soil physical properties, Plant growth, Germination, Photosynthetic pigments, Water soluble salts, Electrical conductivity, Cation exchange capacity, Effluents.

Laboratory experiments were conducted to evaluate the impact of various concentrations (0.5, 5, 10, 25, and 50%) of fertilizer factory effluent on certain physicochemical properties of soil, and germination, growth, photosynthetic pigments, and dry matter productions of corn and rice. The effluent was highly alkaline and contained high amounts of N(+), Ca(2+), Na(+), Cl(-), CO3(2-), HCO3(-), and suspended and dissolved solids. Its biological oxygen demand value was also high. The effluent treatment to soil resulted in a significant increase in the water soluble salt, electrical conductivity, cation exchange capacity, pH, N, Ca, Na, and Cl content of the soil for effluent concentrations of 10% and above. The effluent in the lower concentrations of 2.5 and 5% enhanced the growth and development of corn and rice. Higher concentrations of effluent (10% and above), however, inhibited the percentage of seed germination and caused deleterious effects on the dry matter production, yield (quantitative and qualitative) and the photosynthetic pigments of both test corps. (Author's abstract)
W88-00099

APPLICATION OF A CONCEPTUAL MODEL TO IRRIGATION WATER REQUIREMENT AND SALT TOLERANCE OF CROPS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3F.
W88-00107

WATER REUSE.
For primary bibliographic entry see Field 5D.
W88-00164

MUNICIPAL WASTEWATER IN AGRICULTURE.
Proceedings for the International Conference on the Status of Knowledge, Critical Research Needs, and Potential Research Facilities Relating to: The Cooperative Research Needs for the Renovation and Reuse of Municipal Wastewater in Agriculture, Morelos, Mexico, December 15-19, 1980. Academic Press, NY. 1981. Edited by F. M. d'Itri, J. A. Martinez, and M. A. Lambarri. 492 p.

Descriptors: *Wastewater renovation, *Water reuse, *Wastewater irrigation, *Conferences, *Recycling, *Mexico, Symposium, Municipal wastewater, Legal aspects, Pathogens, Heavy metals, Design criteria, Cost analysis, Economic aspects, Arid lands, Irrigation practices, Irrigation programs.

At Cocoyoc, Morelos, Mexico, representatives of Mexico and the United States gathered to consider their need for close cooperation on numerous scientific topics, in particular wastewater renovation and reuse by agriculture. Researchers familiar with various wastewater irrigation techniques presented construction designs, operational guidelines, and data for these systems. Discussions focused on related problems such as the nature, distribution, and fate of viruses, bacteria and pathogenic organisms, as well as organic and inorganic contaminants. Practical suggestions were offered on how to utilize land irrigation techniques, resolve the problems that arise, accumulate data, prevent some potential hazards, and promote the most effective recycling of wastewatwer at the least expense to the economy or hazard to human health. Besides exchanging data and ideas, plans were initiated for future cooperation in such endeavors to improve the quality of research, prevent overlap, and encourage mutual assistance. The contents of the conference proceedings contains presentations on the administrative and legal aspects of wastewater renovation and reuse, reuse alternatives for municipal wastewater, operation of land treatment systems, pathogens and heavy metals in municipal wastewater, design and cost criteria for land treatment systems, and research needs for renovation and reuse. (See W88-00271 thru W88-00290) (Geiger-PTT)
W88-00270

ROLE OF THE MEXICAN STATE AND FEDERAL GOVERNMENTS IN THE PROMOTION AND COORDINATION OF WASTEWATER RENOVATION AND REUSE,
Ministry of Agriculture and Water Resources, Mexico City.
J. A. Martinez.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 1-11.

Descriptors: *Wastewater renovation, *Mexico, *Water use, *Wastewater management, *Wastewater irrigation, Recycling, Pilot plants, Political aspects, Irrigation programs, Public health, Municipal wastewater, Economic aspects.

Mexico, a country already limited in water resources, is faced with the problem of supplying water to an ever growing population. Technical and economic feasibility studies have been carried out for the massive reuse of water in Monterrey, N.L., Tijuana, and Baja California, the reutilization districts for industrial supply in the Valley of Mexico, and the program of Water Quality Control Districts. Pilot treatment plants have demonstrated the viability of wastewater reuse. However, its implementation and execution is impeded in some cases by political and socioeconomic repercussions. Water resources administration in Mexico is governed by the 1971 Federal Water Law. The administration of water for domestic and urban use is carried out by organizations at the city level. Water to irrigate crops is administered by SARH. Management options allow industry and agriculture to reuse municipal wastewater while the government supplies first use water to the population. Because most water in Mexico is free, the policy of subsidizing the cost of potable water must be eliminated in order to promote water reuse. Stricter pollution controls must be enforced to make water reuse viable. Human health should be considered when renovated wastewater is to be used on crops or pastureland, in industry or for recreational purposes. (See also W88-00270) (Geiger-PTT)
W88-00271

ROLE OF FEDERAL AND STATE AGENCIES TO STIMULATE, COORDINATE, AND FUND RESEARCH RELATED TO THE RENOVATION AND REUSE OF MUNICIPAL WASTEWATER IN THE UNITED STATES,
Bureau of Reclamation, Washington, DC. Office of Water Research.
For primary bibliographic entry see Field 5D.
W88-00272

ADMINISTRATIVE ASPECTS FOR THE RENOVATION AND REUSE OF WASTEWATER,
Engineering and Water Quality Lab., Mexico City.
For primary bibliographic entry see Field 5D.
W88-00273

WORLDWIDE ASPECTS OF MUNICIPAL WASTEWATER RECLAMATION AND REUSE,
American Water Works Association Research Foundation, Denver, CO.
R. D. Heaton.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 43-47, 10 fig, 8 tab.

Descriptors: *Wastewater renovation, *Water reuse, *Reclaimed water, *Water reuse, Water use, Wastewater irrigation, Municipal wastewater, Advanced wastewater treatment, Wastewater treatment, Recycling, Arid lands, Research priorities.

The popularity of reclamation and reuse of municipal effluents has increased over the past 10 years. In the U.S., over 50% of the reuse in the year 2000 is projected to occur in the midwest or west. The first national legislation to promote reuse was the Water Pollution Control Act passed in 1972. Few countries outside the U.S. have formal water reuse policies on the national level. A comprehensive marketing survey for reuse application was completed by the East Bay Dischargers Authority near San Francisco, California. A 1972 survey of international reuse projects resulted in data on 134 different sites. Israel's target reuse project is the Dan River Project. In Saudi Arabia an ambitious recycling effort is taking place at a refinery near Riyadh. Water reuse should play a major role in Iran's industrial development. Reclamation of wastewater for human use still occurs at the Windhoek facility in southwest Africa or Namibia. Construction of a pilot facility in Dordrecht, the Netherlands has resulted in considerable data toward full-scale reclamation plant construction. In 1973, a Water Reuse Promotion Center was established in Japan to encourage and coordinate water recycling throughout the country. In Hong Kong, advanced wastewater treatment processes are being investigated for wastewater reuse. Research is being carried out in Australia to use reclaimed wastewater for irrigating forests, timberland, and agricultural crops. Hawaii is experimenting with water reuse for crop irrigation. The Island of Bali and the Virgin Islands are considering water reclamation. Water recycling experiments will be conducted in space. (See also W88-00270) (Geiger-PTT)
W88-00274

REUSE OF MUNICIPAL WASTEWATER FOR INDUSTRIAL PURPOSES IN MEXICO CITY,
Disenos Hidraulicos y Technologia S.A.,Mexico City.
O. E. Espino.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 75-86, 3 fig, 2 tab.

Descriptors: *Water reuse, *Wastewater renovation, *Wastewater treatment, *Wastewater facilities, *Advanced wastewater treatment, *Mexico, Reclaimed water, Recycling, Design criteria, Chemical treatment, Tertiary wastewater treatment, Wastewater irrigation, Municipal wastewater.

The average generation of wastewater in the metropolitan area of the Federal District (Mexico City) is about 30 cu m/sec. Of the total wastewater generated, about 8 cu m/sec is used for agricultural irrigation in 1800 ha in the Valley of Mexico. Reclaimed wastewater is also used in the Valley of Mexico for the thermoelectricity industry and a refinery. Some measures which should be considered in strategies for the reuse of water in industry in the Valley of Mexico are economic, financial, technical, educational, and instrumental measures. The reuse plant in Lecheria provides an attractive option for using wastewater for industrial purposes. A series of tests were carried out to establish the treatability of the wastewater coming into the plant. The treatment plant design chosen uses screens with automatic cleansing mechanisms and circular grit chambers. Treatment consists of primary sedimentation, an activated sludge system, and secondary clarification. In the wet season, a tertiary, chemical treatment system may be used. Costs of the treated water are estimated between $0.11 and $0.19/cu m. (See also W88-00270) (Geiger-PTT)
W88-00275

MUNICIPAL WASTEWATER REUSE FOR DENVER,
Culp/Wesner/Culp, Denver, CO.
M. R. Rothberg, S. W. Work, and W. C. Lauer.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 87-103, 3 fig, 2 tab, 7 ref.

Descriptors: *Wastewater treatment, *Denver, *Colorado, *Wastewater renovation, *Water reuse, *Wastewater facilities, *Reclaimed water, Design criteria, Recycling, Municipal wastewater, Future planning, Pilot plants, Cost analysis, Project planning.

For Denver, Colorado, the only viable option for water reuse is potable reuse. In order to meet its current annual requirements of supplying 308 million cu m of water, the Denver Water Department has an extensive raw water collection, storage, and transmission system. Denver has also evaluated alternatives for dual distribution system reuse and a form of reuse known as exchange, the simplest form of successive use. In 1978, the Department again hosted a meeting of various experts from its own staff, outside consultants and the EPA to evaluate and recommend a workable and reliable treatment process. The demonstration plant which resulted from Phase I of the reuse program removes phosphorus by high lime precipitation, nitrogen by an ion exchange process, and soluble organics by granular activated carbon. Disinfection is by chlorine dioxide. Phase II of the Departments reuse program involves extensive analytical and health effects testing of treated wastewater. Extensive physical, biological, organic, inorganic, and radiological parameters will be stored on the monitoring computer system. A series of in vivo and in vitro tests for genetic effects of treated concentrates would be carried out. The overall costs of the project are estimated at $27.6 million. The project is expected to provide up to 15% of the city's municipal water supply by the year 2000. (See also W88-00270) (Geiger-PTT)
W88-00276

PROGRAM FOR THE REUSE OF WASTEWATER IN MEXICO CITY,
Departmento del Distrito Federal, Mexico City. Construcion y Operacion Hidraulica.
G. G. Villalobos, G. M. Gamez, and F. F. Herrera.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 105-144, 10 fig, 10 tab.

Descriptors: *Wastewater treatment, *Wastewater renovation, *Water reuse, *Future planning, *Mexico, Recycling, Project planning, Tertiary treatment, Wastewater facilities, Advanced wastewater treatment.

A review of Mexico City's hydraulic system and programs for wastewater reuse are outlined. Cost analysis studies were made on the rehabilitation of existing treatment systems to handle wastewater renovation to meet the demands of a growing population. Seven reuse systems were designated as part of the wastewater reuse program. System 1 consists of transporting the wastewater through the primary sewerage and drainage network to the wastewater treatment plant. System 2 consists of rehabilitating the existing treatment plants to irrigate agricultural crops which are not eaten raw, for green areas, to fill recreational lakes, and for possible use in industry. System 3 applies treated water to irrigate agricultural areas where the products are not eaten raw and in the municipalities of Chalco, Cuautitlan, and Texcoco. System 4 uses tertiary-treated wastewater for industry, business, services, public and recreational needs. System 5 applications will be for aquifer recharge. System 6 will supply potable water through tertiary treatment. System 7 will recirculate water within individual houses and recirculate treated wastewater. Relationships between the Treatment and Reuse Master Plan, the Federal Districts hydraulic system, the Federal government, the State governments, the neighborhood councils, and the development plans are discussed. (See also W88-00270) (Geiger-PTT)
W88-00277

OPERATION OF A PILOT MUNICIPAL WASTEWATER TREATMENT PLANT FOR AGRICULTURAL REUSE,
Ministry of Agriculture and Water Resources, Mexico City. Center for Research in Water Reuse.
R. S. Alba, and I. L. Ramirez.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 145-161, 5 fig, 7 tab.

Descriptors: *Pilot plants, *Wastewater renovation, *Water reuse, *Wastewater irrigation, *Wastewater treatment, *Mexico, Chlorination, Wastewater facilities, Biological wastewater treatment, Physicochemical treatment, Crop production, Chemical treatment, Irrigation programs, Recycling.

A pilot demonstration plant was built at Monterrey, N.L., Mexico to evaluate the technical advantages of the different processes available for wastewater treatment for agricultural reuse. Three different forms of operation were evaluated: complete treatment in series, which includes primary, secondary, and physical-chemical treatments; primary plus physical-chemical treatment; and biological treatment plus chlorination. Results showed that the effluent from biological treatment can be used to irrigate crops under certain conditions. The crop system to be irrigated should not have fruit that is eaten raw. Aerosol formation should be avoided during wastewater irrigation. For canal irrigation, the distance between the soil and the edible part of the plant should be taken into account. No root crops which are eaten raw by humans should be irrigated unless the chlorination process is increased and the concentration of fecal coliforms is reduced to less than 2.2 organisms/100 ml. A similar analysis could be carried out for each of the effluents in relation to each of the uses of wastewater being considered. (See also W88-00270) (Geiger-PTT)
W88-00278

LAND TREATMENT: A VIABLE SOLUTION FOR MANAGEMENT OF WASTEWATER IN THE METROPOLITAN AREA OF THE VALLEY OF MEXICO,
Eco-Ingenieria S.A., Mexico City.
H. M. Marquez.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 163-193, 3 fig, 19 tab, 23 ref.

Descriptors: *Wastewater irrigation, *Wastewater treatment, *Land application, *Wastewater renovation, *Wastewater management, *Mexico, Land disposal, Reclaimed water, Percolation, Recycling, Water reuse, Heavy metals, Crop production, Public health, Pathogens.

The use of wastewater from the metropolitan area of Mexico City (MAMC) for irrigation in Irrigation District 03 provides nutrients for the growth of food stuffs. Pretreatment is recommended for wastewater intended for application to fodder crops. By percolating through the soil, the wastewater receives a level of treatment which is superior to secondary treatment, thus reducing pollution downstream. Wastewater irrigation in Irrigation District 03 of the MAMC poses many hazards to public health in that pathogenic organisms are present on crops that are eaten raw. Heavy metals in wastewater are accumulated in the District's soil and are introduced into the human trophic food chain through the fodder fed to cattle. The treatment of MAMC's wastewater by land application is possible if irrigation is carried out in an isolated area exclusively on fodder crops, the levels of heavy metals in wastewater are controlled at the source, and essential and basic sani-

tary services are provided for the people who work in the area irrigated with wastewater. (See also W88-00270) (Geiger-PTT)
W88-00279

FLUSHING MEADOWS PROJECTS - WASTEWATER RENOVATION BY HIGH RATE INFILTRATION FOR GROUNDWATER RECHARGE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer, and R. C. Rice.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 195-215, 3 fig, 2 tab, 22 ref.

Descriptors: *Wastewater treatment, *Water reuse, *Infiltration, *Groundwater recharge, *Wastewater renovation, *Public health, *Arizona, Recycling, Aquifers, Induced infiltration, Land application, Wastewater management, Wastewater disposal, Economic aspects.

When sewage effluent is to be used for irrigation, the agronomic and public health aspects must be considered. Salinity levels of sewage effluent are generally not a problem for crops. Heavy metals in wastewater may have phytotoxic effects or effects on animal or human health. Hay crops can utilize high N levels in sewage effluent. Excessive N levels may reduce crop yield while increasing vegetative growth. N levels in wastewater may be reduced by further tertiary treatment or by dilution of the wastewater to be used for irrigation. Toxic elements in wastewater can affect human health directly, when farm workers are exposed to irrigation aerosol or sewage-treated soil, or indirectly (through ingested farm products). The additional purification that conventionally treated sewage effluent needs in order to meet the standards for unrestricted irrigation is effectively obtained by groundwater recharge. Rapid infiltration systems require relatively permeable soil to obtain high infiltration rates. Considerable field studies and testing are needed to determine the optimum design and management of such a system. The Flushing Meadows Project near Phoenix, Arizona was started in 1967 to determine the quality of renovated wastewater that could be achieved. The favorable results of this project prompted the construction of a larger system (23rd Avenue project) to produce renovated water on a commercial basis. The quality of water produced by the 23rd Avenue project was similar to that of the Flushing Meadows project. The advantages of using primary effluents for infiltration are costs savings and a higher organic carbon content which will enhance denitrification in the soil. (See also W88-00270) (Geiger-PTT)
W88-00280

AGRICULTURAL LAND IRRIGATION WITH WASTEWATER IN THE MEZQUITAL VALLEY,
Valley of Mexico Water Commission, Mexico City.
J. C. Moreno.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 217-248, 6 fig, 6 tab, 14 ref.

Descriptors: *Wastewater irrigation, *Water reuse, *Irrigation programs, *Water use, *Future planning, *Mexico, Wastewater treatment, Recycling, Salinity, Crop production, Industrial water, Water resources development, Water supply.

In 1960, studies were initiated on the reuse of wastewater in the Valley of Mexico and the Mezquital Region. Wastewater was found to be high in salinity. Salinity increased after long storage periods. High levels of detergents in the wastewater decreased the growth of calves. Boron in the wastewater was toxic to beans at concentrations of 5 mg/liter and to lettuce at concentrations of 5 mg/liter. The effects of various irrigation waters on crop production are examined. Regulations for the control of wastewater used in agricultural irrigation were drawn up in 1970. Extensions of wastewater irrigation schemes will continue to collect wastewater at the Drainage Canal, in the southern extension of the Great Canal, and Lake Zumpango. For the Central Zone Water Plan, the supply source will be the Endo Dam. The volumes required for the years 1975, 1980, 1990 and 2000 are estimated as well as the wastewater volume which could be exploited by the industry. Available water resources for the future are the natural basins draining directly to the Western Outfall and the wastewater and rainfall generated in the metropolitan area of Mexico City. In the future wastewater irrigation will be extended to areas with medium to light texture with good permeability and a high content of Ca and Mg carbonates. (See also W88-00270) (Geiger-PTT)
W88-00281

MICHIGAN STATE UNIVERSITY WATER QUALITY MANAGEMENT FACILITY - A LAKE-LAND SYSTEM TO RECYCLE MUNICIPAL WASTEWATER,
Michigan State Univ., East Lansing. Inst. of Water Research.
T. M. Burton, and D. L. King.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 249-269, 1 fig, 4 tab, 15 ref.

Descriptors: *Wastewater irrigation, *Recycling, *Wastewater renovation, *Crop production, Land application, Wastewater disposal, Lakes, Wastewater treatment, Municipal wastewater, Water quality, Nitrogen, Phosphorus, Nutrients, Water reuse.

The Water Quality Management Facility (WQMF) at Michigan State University is a combined land-lake system for research on treatment and recycle of municipal wastewater. The WQMF was constructed in 1973 cooperatively with a new activated sludge, tertiary sewage treatment facility. Phosphorus and nitrogen removal by the lake have proven excellent. Fish management requires removal of macrophytes or aeration. Wastewater lakes attenuate populations of fecal coliform bacteria. Research on the land portion of the WQMF has emphasized a mass balance approach for the major nutrients with attempts made to quantify inputs, outputs, plant uptake, and storage within the system. Spray irrigation studies were conducted on old abandoned fields, tree seedling plantations, late successional sugar maple, small crop plot studies of several varieties of annual and perennial forages, and on soybeans. Cottonwood and Scotch pine had the fastest growth rates under irrigated conditions. The annual grasses produced the highest N yields. Alfalfa yielded almost as much dry matter per hectare as did the annuals with substantially more N removal. Tall fescue, orchardgrass, Kentucky bluegrass, and reed canarygrass all had excellent N yields at the higher irrigation rates (5.0-7.5 cm/week). Studies of harvest vs. mowing for Kentucky bluegrass showed that grasses maintained their effectiveness at N removal regardless of whether the cut vegetation was removed or not. Studies of P on the crop plots showed that all P applied in wastewater had either been removed by harvest or remained in the upper 15 cm of soil after 5 yr of irrigation. Several recommendations for operation of a combined land-lake wastewater recycling system are considered. (See also W88-00270) (Geiger-PTT)
W88-00282

MICROBIOLOGICAL HEALTH EFFECTS ASSOCIATED WITH THE USE OF MUNICIPAL WASTEWATER FOR IRRIGATION,
Health Effects Research Lab., Cincinnati, OH.
N. E. Kowal, H. R. Pahren, and E. W. Akin.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 271-342, 22 tab, 144 ref.

Descriptors: *Wastewater irrigation, *Wastewater renovation, *Pathogens, *Parasites, *Public health, Water reuse, Reclaimed water, Land disposal, Wastewater disposal, Wastewater management, Wastewater treatment, Pathogenic bacteria, Viruses.

With the application of large volumes of minimally pretreated wastewater to agricultural land, considerable potential exists for adverse health effects of land treatment. The microbial agents of concern from a health effects viewpoint include bacteria such as Salmonella and Shigella; viruses such as enteroviruses, hepatitus, adenoviruses, rotaviruses, and Norwalk-like agents; protozoans such as Entamoeba and Giardia; and helminths or worms such as Ascaris, Frichuris, and Toxocara. For each agent, the types and levels usually found in municipal wastewater and the efficiency of preapplication treatment (usually stabilization pond) are briefly reviewed. The levels of the agent usually found, behavior, and survival of the agent in the medium or route of potential human exposure (in aerosols, in surface soil or in plants) are discussed. The infective dose, risk of infection, and epidemiology of the pathogens are outlined. It is concluded that the occurrence of viruses be based on viral tests rather than bacterial tests. Where the minimum level of preapplication treatment (properly-designed sedimentation) is used, public access should be limited to between 100 and 200 m from the spray source. Waiting periods for harvest should be observed. Humans should have a minimum amount of contact with land treatment sites. (See also W88-00270) (Geiger-PTT)
W88-00283

EVALUATING THE FECAL CONTAMINATION IN FRUITS AND VEGETABLES FROM MARKETS IN MEXICO CITY,
Universidad Nacional Autonoma de Mexico, Mexico City. Dept. of Human Ecology.
I. H. Arteaga, J. T. Zavala, P. M. Schettino, and C. M. Jimenez.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 343-350, 2 tab, 9 ref.

Descriptors: *Wastewater irrigation, *Wastewater disposal, *Public health, *Feces, *Fruit crops, *Vegetable crops, *Mexico, Wastewater renovation, Water reuse, Enteric bacteria, Coliforms, Crop production, Bactericides.

In Mexico, feces may be carried by rainwater and become part of the normal sewage discharges which are used for agricultural irrigation. The fecal contamination of fruits and vegetables sold in the Xochimilco, Jamaica, and Merced markets of Mexico City were examined using enterobacteria as indicators of fecal contamination. In the three markets on all of the dates when foodstuffs were sampled, high percentages of coliforms were isolated, indicating the presence of fecal contamination. The bacterial coliforms most frequently encountered were Escherichia coli and Enterobacter aerogenes. Of the four treatment methods tested, the most effective were scalding and treatment with a bacteriocide. The use of a bacteriocide leaves an unpleasant taste on fruit and vegetables, while scalding causes some vegetables to lose their freshness. Where bacteriocides are unavailable, a meticulous washing with running water is highly recommended. Of the three bacteriocides tested in the study, the Elibac solution containing chlorine salts proved to be the most efficient. The Merced market had higher levels of hygiene than the other two markets examined. (See also W88-00270) (Geiger-PTT)
W88-00284

TRACE METALS IN SOILS AND PLANTS RECEIVING MUNICIPAL WASTEWATER IRRIGATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
A. L. Page, and A. C. Chang.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 351-372, 8 tab, 23 ref.

Descriptors: *Wastewater disposal, *Wastewater irrigation, *Wastewater renovation, *Trace metals, *Soil amendments, Water reuse, Recycling, Wastewater management, Trace elements, Wastewater treatment, Heavy metals, Crop production, Irrigation programs, Municipal wastewater.

This chapter reviews possible accumulation of trace metals in soil through the use of wastewater in irrigation, and its possible impact on the growth and chemical composition of crops. Concentrations of trace metals in wastewater following treatment at a municipal wastewater plant depend largely upon inputs and the extent of treatment. Primary treatment effectively removes high percentages of many trace metals from wastewaters. Secondary treatment removed 60 to 80% of the total Cd, Cr, Cu, Hg, Pb, and Zn from the primary effluent. Advanced wastewater treatment systems are not very effective in removing boron caused by use of detergents. Concentrations of trace metals in surface waters are considerably less than those for wastewaters. Since growing plants are more likely to be injured by the input of trace metals to soils through external pathways (soil amendments, irrigation water and waste disposal), it is essential that the trace metal content of irrigation water be carefully monitored. The phytotoxicity of an element also depends on cultivation practices, plant species and soil types. Trace metals are immobilized in soil by adsorption, precipitation, cation exchange, and formation of complexes with organic or inorganic ligands in the soil. Available data suggest either slight or no accumulation of trace metals in the soil profile or root zone following long term use of wastewater for irrigation. Based upon available data, it appears that treated wastewaters can be used as a source of irrigation water for at least a number of decades before trace metals will accumulate to levels considered hazardous. (See also W88-00270) (Geiger-PTT)
W88-00285

TREATMENT AND FINAL DISPOSAL OF MUNICIPAL WASTEWATER AND SLUDGE ON THE LAND: PRESENT PRACTICES,
Monterrey Univ. (Mexico). Dept. of Civil Engineering.
A. R. Alcazar.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 373-387, 4 fig, 19 ref.

Descriptors: *Wastewater disposal, *Wastewater irrigation, *Land disposal, *Irrigation practices, *Wastewater renovation, Irrigation programs, Sludge disposal, Land application, Wastewater treatment, Sprinkler irrigation, Heavy metals, Infiltration, Percolation, Crop production.

Present practices in land disposal of wastewater include irrigation of crops, golf courses, cemetaries and parks. Wastewater is applied by overland flow land application, spray irrigation, and infiltration-percolation. For overland flow land application, a living filter has been developed based on the soil vegetation ecosystem. For spray irrigation, the main objective is to take advantage of the water and its fertilizing properties to obtain crops of economic value for human or animal consumption. The objective of infiltration-percolation is to optimize the recharge of groundwater with water of an acceptable quality at the maximum possible rates throughout the year. The living filter system requires careful balance of water and organic material to maintain aerobic conditions in the soil. The sprinkle irrigation method applies water under pressure through spray nozzles. Irrigation by the ridge and furrow method is also a common agricultural practice. Adequate pretreatment of the liquid industrial wastes is necessary to avoid unacceptable concentrations of heavy metals and other toxic substances. Soil pH should be > 6.5 when sludge is applied to prevent accumulation of heavy metals in the food chain. In Sweden, pasteurization of sludge is recommended before application to farmland. (See also W88-00270) (Geiger-PTT)
W88-00286

DESIGN FACTORS FOR THE RAPID INFILTRATION, OVERLAND FLOW, AND SLOW RATE IRRIGATION WASTEWATER LAND APPLICATION SYSTEMS,
Culp/Wesner/Culp, Cameron Park, CA.
G. Culp, and D. Hinrichs.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 389-426, 6 fig, 16 tab, 12 ref.

Descriptors: *Wastewater irrigation, *Wastewater treatment, *Irrigation programs, *Irrigation practices, *Wastewater disposal, Water reuse, Wastewater management, Infiltration, Crop production, Percolation, Land application, Overland flow.

The design criteria and features of rapid infiltration, overland flow, and slow rate irrigation wastewater land application systems are reviewed. Overland flow treatment is best suited for areas with impermeable soils. Overland flow provides treatment by filtration and microbial activity in the surface soil and vegetation. Infiltration-percolation systems provide treatment by wastewater vertically filtering through the soil mantle. Treatment is accomplished by biological growth at or near the soil surface and filtration and soil adsorption in the unsaturated zones below. Slow rate irrigation systems are applied without water damage to crops. Pretreatment of wastewater prior to use in slow rate irrigation systems should be based primarily on the type of crops grown. The most common irrigation systems are the mechanical move (center pivot, moving gun and wheel line), permanent or solid set sprinklers, and surface application systems. A design example for a slow rate system takes into account the site, climate, application rate, storage reservoir, land area, irrigation system, nitrogen balance and sodium adsorption ratio. Loading rates of overland flow systems are based on the level of wastewater pretreatment. The distribution through such systems are by gated pipe or spray method. To enhance N removal and maintain good percolation rates, most rapid infiltration systems are flooded intermittently followed by a drying period. Of the three land systems, rapid infiltration is the least sensitive to cold weather. Rapid infiltration requires little pre-application, but subsurface drainage may be required, depending on groundwater level and movement. (See also W88-00270) (Geiger-PTT)
W88-00287

COMPARATIVE COSTS OF LAND TREATMENT VERSUS CONVENTIONAL WASTEWATER TREATMENT,
Economic Research Service, University Park, PA.
C. E. Young.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 427-452, 1 fig, 10 tab, 14 ref.

Descriptors: *Wastewater irrigation, *Wastewater renovation, *Advanced wastewater treatment, *Model studies, *Land application, *Cost analysis, Simulation analysis, Irrigation practices, Irrigation programs, Water reuse, Models, Wastewater treatment, Wastewater disposal, Comparison studies.

An engineering simulation model was used to compare land application costs with those of conventional advanced wastewater treatment. The Cost of Land Application of Wastewater (CLAW) model was used to simulate land treatment systems under a variety of scenarios. Results showed that rapid infiltration systems are the least costly of the systems examined, followed by overland flow, center pivot irrigation, and solid set irrigation, in that order. Land application systems are relatively capital intensive with a four-to-one ratio of capital to operation and maintenance costs. Introduction of net crop revenue, except for rapid infiltration systems, further reduces the variable system costs. Conventional advanced wastewater treatment (AWT) systems were also simulated. The AWT system is generally more expensive than land application. Sensitivity analysis indicated that extending the irrigation season and the application rate as much as possible lowers the amount of land and need for irrigation equipment. Future research needs include better data on costs, crop responses, and offsite impacts. These issues need to be resolved before land application is likely to gain widespread acceptance as an advanced wastewater treatment method. (See also W88-00270) (Geiger-PTT)
W88-00288

RESEARCH NEEDS RELATED TO MUNICIPAL WASTEWATER RENOVATION AND REUSE IN ARID AND SEMIARID AREAS,
New Mexico Water Resources Research Inst., Las Cruces.
T. G. Bahr.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 453-461, 3 tab.

Descriptors: *Wastewater renovation, *Recycling, *Wastewater irrigation, *Wastewater management, *New Mexico, Groundwater depletion, Consumptive use, Legal aspects, Public health, Land disposal, Economic aspects, Irrigation practices, Irrigation programs, Water demand, Municipal wastewater, Future planning, Wastewater disposal.

The five year water research plan of the New Mexico Water Resources Research Institute outlines a listing of research needs that identify critical water problems for the state of New Mexico and the region. New Mexico's groundwater supplies are potentially threatened by continued groundwater pumping. Water depletions or consumptive use in the United States amounts to about one-third of that withdrawn. A 10% improvement in irrigation efficiency for New Mexico saves an amount of water equivalent to all other uses combined. Recycling municipal wastewater, if coupled with a program of reducing municipal withdrawals, would conserve only about 5% of the total water used in New Mexico. The research needs related to municipal wastewater recycling in New Mexico include studies to determine the legal ramifications of alternative recycling systems, continued studies to assess the public health risks of different wastewater management methods, and studies of an economic nature to better determine the value of municipal wastewater. (See also W88-00270) (Geiger-PTT)
W88-00289

RESEARCH NEEDS IN MEXICO WITH RESPECT TO THE RENOVATION AND REUSE OF DOMESTIC WASTEWATER,
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
R. Cuellar-Chavez.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 463-476, 7 tab, 9 ref.

Descriptors: *Wastewater irrigation, *Municipal wastewater, *Wastewater disposal, *Wastewater renovation, *Research priorities, *Mexico, Land application, Wastewater treatment, Irrigation practices, Irrigation programs, Crop production, Land disposal, Recycling, Water reuse.

In Mexico, various studies were carried from 1970 to 1980 on the use of municipal wastewater for crop irrigation. In other countries, limited applications of wastewater irrigation have been made. Research is needed to evaluate the effects on the soil in various regions where untreated municipal wastewater has been used for irrigation over time; analyze the crop yield variations; determine the level of crop pollution; study the survival of pathogenic organisms in wastewater, soil, and crops; evaluate the health effects of untreated wastewater on agricultural workers; and analyze the irrigation techniques with wastewater. Each case eligible for wastewater irrigation should be analyzed separately, considering the soil characteristics and the crops to be irrigated. This process of analysis should take into account the available technology for wastewater treatment to design or adapt low cost processes for agricultural irrigation. Some processes which should be studied are: Imhoff tanks, primary sedimentation, stabilization ponds (with low retention periods), and ponds with aquatic weeds. (See also W88-00270) (Geiger-PTT)
W88-00290

COPING WITH SALINITY,
J. Van Scilfgaarde, and J. D. Rhoades.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 157-179, 1 tab, 45 ref.

Descriptors: *Impaired water use, *Saline water, *Agriculture, Desalination, Brackish water, Water

scarcity, Water management, Water use, Irrigation, Water reuse, Salt tolerance.

Four independent management strategies are identified to cope with increasing levels of salinity. First, saline springs or other point sources of saline water can be intercepted; the water then can be evaporated, desalted, and reused, or diverted for use in industrial applications. Second, the amount of water applied for irrigation can be reduced, thus lessening the amount that seeps through the soil and reducing the salt load in return flows. Third, somewhat saline water can be used as a source of irrigation water for salt-tolerant crops. Such use reduces the amount of brackish water needing disposal and provides a substitute water supply. Fourth, the cropping pattern can be changed by choosing tolerant rather than sensitive crops. Through plant breeding more tolerant varieties of common species may become available. None of these options is without cost, and all have socio-economic as well as technical aspects. (W88-00291) (Author's abstract)
W88-00298

METHOD FOR MINING AND RECLAIMING LAND,
For primary bibliographic entry see Field 4A.
W88-00504

PURIFICATION OF HYDROCARBON STREAMS,
Phillips Petroleum Co., Bartlesville, OK.
R. C. Ferguson.
U.S. Patent No. 4,370,236; January 25, 1983. 7 p, 1 fig, 1 tab, 2 ref. Official Gazette of the United States Patent Office, Vol 1026, No 4, p 1271, January 25, 1983.

Descriptors: *Patents, *Hydrocarbons, *Natural gas, *Conduits, *Pollutants, Wash water, Methanol, Glycol, Water quality control.

Contaminants are removed and recovered from hydrocarbons, such as natural gas liquids, by using an aqueous wash liquid. The process comprises contacting a liquid stream comprising C1-C6 hydrocarbons as its major component and particulate and at least one contaminant selected from the group consisting of water, hydrogen sulfide, carbon dioxide, methanol, ethylene glycol, and amine to form a mixture comprising liquid hydrocarbon, aqueous wash liquid and particulate; and electrostatically precipitating the aqueous wash liquid and particulate from the liquid hydrocarbon to form an aqueous phase. A purified liquid hydrocarbon stream is withdrawn from the liquid hydrocarbon phase and a wash stream comprising particulate, water, ethylene glycol and at least one contaminant selected from the group consisting of hydrogen sulfide, carbon dioxide, methanol and amine from the aqueous phase. At least a portion of the particulate is filtered from the wash stream and at least a portion of the filtered wash stream is recycled to the aqueous wash liquid stream. (Cremmins-AEPCO)
W88-00531

USING SATURATED HYDRAULIC CONDUCTIVITIES TO ASSESS THE INTERACTION BETWEEN SALINE/SODIC IRRIGATION WATERS AND SOUTH DAKOTA SOILS,
South Dakota State Univ., Brookings. Water Resources Inst.
J. H. Bischoff, A. R. Bender, C. G. Carlson, and L. O. Fine.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197612/AS. Price codes: A04 in paper copy, A01 in microfiche. Completion Report, June 1984. 45 p, 10 fig, 17 tab, 18 ref, append. Project No. OWRT A-079-SDAK (1). Contract No. 14-34-0001-2144.

Descriptors: *Hydraulic conductivity, *Soil chemical properties, *South Dakota, Darcy's law, Irrigation effects, Soil stability, Irrigation waters, Missouri River, Glaciated soils.

Information has been presented which gives the characteristic performance curves of saturated hydraulic conductivity under different SAR and EC combinations of leaching waters. The most significant finding is that the saturated hydraulic conductivity of soils west of the Missouri River seem to be affected more by changes in EC levels than by SAR levels than are the glaciated soils east of the Missouri River. This may be the result of the inability of the older, non-glaciated, more weathered soils to release cations from the solid phase at low electrolyte concentrations. The younger soils may have the divalent cations in unweathered forms of hornblende, plagioclase, and feldspars to provide some electrolyte during periods of high rainfall, thus maintaining flocculation, preventing clay dispersion, and keeping saturated hydraulic conductivity at a high level. The saturated hydraulic conductivity of West River soils appears to peak at a higher EC level than East River soils at SAR's above 5. (Bischoff-SC St. U.)
W88-00548

DEVELOPMENT OF THE NUTRIENT FILM TECHNIQUE FOR RENOVATION OF WASTEWATER FOR NONPOTABLE USE: DESIGN CRITERIA STUDY,
Florida International Univ., Miami. Drinking Water Research Center.
For primary bibliographic entry see Field 5D.
W88-00552

PROCESS FOR THE UTILIZATION OF WASTE WATERS IN THE HYDROGENATION OF COAL,
Ruhrkohle A.G., Essen (Germany, F.R.).
F.E. Wolowski, and H. Tamm.
U.S. Patent No. 4,597,851; July 1, 1986. 5 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1068, No 1, p 270, July 1, 1986.

Descriptors: *Patents, *Hydrogenation, *Water reuse, *Coal, *Wastewater treatment, *Cooling water, *Industrial wastewater, Wastewater renovation, Distillation, Acids, Condensates.

Coal hydrogenation wastewater is treated using tar acids from distillation as quenching water. The amount of coal oil produced is increased by reducing the amount of tar acid passing into the aqueous phase from the waste water product. The product is recycled to the coal precipitator as quenching water. The demand for processed water and the amount of water required in the hydrogenation of coal are reduced. (Cremmins-AEPCO)
W88-00598

USE OF SALINE WATER FOR BUFFALO GOURD PRODUCTION IN NEW MEXICO,
New Mexico Solar Energy Inst., Las Cruces.
J. Whittier, and B. Goldstein.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205803/AS. Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 214, November 1986. 27 p, 9 fig, 4 tab, 11 ref. State Project No. 1423625.

Descriptors: *Buffalo gourds, *Salt tolerance, *New Mexico, Crop yield, Ethanol, Irrigation water, Saline water, Dissolved solids.

New Mexico's underground water resources include over 15 billion acre-feet of saline water of varying salinity levels. Salt tolerant crops that are capable of producing commercial yields economically may displace more conventional crops and spare the state's precious fresh water for higher uses. Cucurbita foetidissima HBK (buffalo gourd) was grown in wooden tubs in an outdoor setting in an effort to determine starch and alcohol yields. Irrigation waters of 500; 2,000; 4,000; and 8,000 ppm total dissolved solids were applied. Yields of buffalo gourd roots from 2,000 ppm TDS irrigation water were comparable with field trials. Lower root yields were experienced with increasing salinity levels. Alcohol yields were lower for buffalo gourds irrigated with saline water than for field grown buffalo gourds. Results are inconclusive as to why low alcohol yields were achieved. (Whittier-NM St. U.)
W88-00715

SELECTIVE BREEDING PROGRAM TO IMPROVE THE WATER-USE EFFICIENCY AND NUTRITIVE ACCEPTABILITY OF KOCHIA AS A FORAGE GRAZING CROP,
New Mexico State Univ., Clovis. Agricultural Science Center.
H. D. Fuehring, and R. E. Finkner.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205340/AS. Price codes: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 213, November 1986. 47 p, 2 fig, 24 tab, 28 ref. State Project No. 1423642.

Descriptors: *Kochia plants, *Alkaloid, *Salt tolerance, *Oxalate, Saline water, Water use efficiency, Dragendorff's reagent, Forage toxicity, Drought tolerance, Phenotypic differences.

Through selection, slow progress is being made for lower oxalate and alkaloid levels in Kochia scoparia. Oxalate and alkaloid contents varied considerably under different environments. Kochia can thrive at salt levels of irrigation water up to one-third that of salt water, making it a high potential crop where the underground water is brackish. Several phenotypic plant characteristics were observed but none were stabilized in a true breeding line. (Fuehring-NM S. U.)
W88-00716

EVALUATION OF SALT TOLERANCE IN AZOLLA,
New Mexico Univ., Albuquerque. Dept. of Biology.
G. V. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205332/AS. Price codes: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 211, October 1986. 48 p, 8 fig, 15 tab, 18 ref. State Project 1423626.

Descriptors: *Ferns, *Azolla, *Salt tolerance, *Nitrogen fixation, New Mexico, Growth rate, Anabaena, Saline water, Hydroponics.

The aquatic fern Azolla and the symbiotically associated cyanobacteria (blue-green alga) Anabaena azollae is a highly productive system for nitrogen fixation. The tolerance of several species and ecotypes of Azolla to increasing concentrations of salinity as NaCl was compared in environmental chamber studies using nitrogen-free medium. Growth of Azolla mexicana collected near Corrales, New Mexico, was not significantly inhibited in medium containing 50 milliequivalent (meq)/L NaCl compared to the control without added NaCl. At 100 meq/L NaCl yield of Azolla decreased to 42% of the control. Little growth occurred at 150 meq/L NaCl. NaCl concentrations of 50 and 100 meq/L correspond to very high salinity hazard irrigation waters that are unsuitable for ordinary irrigation use. Based on this investigation some saline waters appear to have application for the hydroponic production of Azolla as a nitrogen-rich organic material with potential for use as a feed or compost material. Azolla mexicana was found to be more tolerant of NaCl salinity than salinity imposed by addition of other salts including $MgSO_4$, $MgCl_2$, K_2SO_4, KCl, Na_2SO_4, or $CaCl_2$. When A. mexicana was provided with fixed nitrogen in the medium, it was able to grow in 100 meq/L NaCl without growth inhibition and at 150 meq/L with 68% of the control yield. The symbiotic Anabaena and nitrogen fixation thus appear to be more sensitive to NaCl inhibition than the host fern when supplied with fixed nitrogen. (Johnson-NM U.)
W88-00718

CRITERIA FOR THE IDENTIFICATION OF POTENTIAL SITES FOR IRRIGATION WITH SALINE WATERS IN NEW MEXICO,
New Mexico State Univ., Las Cruces. Dept. of

Civil Engineering.
J. W. Hernandez.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205324/AS. Price codes: A05 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 209, August 1986. 71 p, 7 fig, 10 tab, 23 ref. State project 1423621.

Descriptors: *New Mexico, *Irrigation water use, *Saline water use, Conjunctive use, Environmental constraints, Tularosa Basin, Estancia Basin, Roswell-Artesian Basin.

New Mexico is an arid state with major groundwater resources and a very large land-area. Approximately 30 to 40% of the state's land-area would be suitable for irrigated agriculture if water were available. The problem is that 90% of the state's groundwater reserves are characterized as 'saline'. Under the right conditions, saline water can be used in irrigated agriculture as an alternative to fresh water, as a supplement to a fresh water supply or in conjunction with better quality water. This last area holds the greatest promise for New Mexico. The combined planned and scheduled use of saline and fresh waters to irrigate common regional crops shows promise. This report is directed at identifying criteria for the selection of appropriate sites. The Tularosa Basin is used as an example area to test the criteria developed with appropriate land areas identified where the conjunctive use of fresh and slightly saline water is possible. Several other areas in the state also are identified where conjunctive use probably can be conducted without severe adverse environmental effects. (Hernandez-NM St. U.)
W88-00720

OPTIMIZATION OF IRRIGATION SCHEDULING WITH ALTERNATIVE SALINE WATER SUPPLIES IN THE ROSWELL - ARTESIA BASIN, 1985,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Economics and Agricultural Business.
R. R. Lansford.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205795/AS. Price codes: A06 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 207, June 1986. 95 p, 24 fig, 29 tab, 38 ref, append. State project No. 1423621.

Descriptors: *Saline water use, *Irrigation scheduling models, *Optimal water use, *Optimization, Farm profits, Roswell-Artesia Basin, Water costs, New Mexico, Model studies, Economic models.

New Mexico's freshwater resources are limited, but significant amounts of groundwater resources remain largely unused due to high salinity levels. Little effort has been made to utilize these aquifers for agricultural production. The primary objective of this report is to develop an irrigation scheduling model that maximizes profits in irrigation from combined use of fresh and saline water and to determine the extent to which saline water can augment fresh water supplies for irrigation. The study area analyzed is the Roswell-Artesian Basin, one of New Mexico's prime agricultural areas that has abundant saline water resources. Three models were developed. Two of the models are irrigation scheduling models that predict yield based upon weather patterns and combinations of saline and fresh irrigation water. The third model, developed to interface with either of the first two, is an economic model that determines the optimal combination of fresh and saline irrigation water. The value of saline water to agriculture can also be determined by the economic model. The results from the study indicate that saline water can be used for irrigated agriculture and that allowing unlimited pumping of saline water in the basin probably could increase farm profitability. (Lansford-NM St. U.)
W88-00722

PRELIMINARY STUDIES CHARACTERIZING WASTEWATER FROM THE INTENSIVE CULTURE OF CHANNEL CATFISH AND NITRIFICATION IN LABORATORY SCALE SUBMERGED FILTERS,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
R. B. Jacquez.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205787/AS. Price codes: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 205, June 1986. 53 p, 9 fig, 9 tab, 35 ref. State project No. 1423620.

Descriptors: *Salinity, *Catfish, *Nutrient production, *Nitrification, *Submerged filter, Respirometer, Water quality, Monitoring, Wastewater.

A study was conducted to determine the pollutional load generated by catfish cultured under a salinity range of 1000 to 9000 mg/L TDS and to evaluate the effect of high salinity on the process of biological nitrification in laboratory scale submerged filters. Water quality parameters that were monitored included: COD, BOD5, PO4-P, Organic-P, NH3-N, NO3-N, Organic-N, SS, and VSS. A respirometer study also was performed to determined the influence of high salinity on the exertion of nitrogenous BOD. The results of the wastewater characterization study demonstrated that increasing the salinity from 1000-3000 mg/L TDS stimulated nutrient production, while increasing the salinity from 3000 to 9000 mg/L TDS decreased the nutrient production rates. Catfish nutrient production rates under saline conditions were approximately 57% less than those reported in the literature for catfish cultured in fresh water systems. A salinity level of 3000 to 5000 mg/L TDS optimized nitrification while a TDS level of 5000 to 9000 mg/L inhibited nitrification in a submerged upflow filter. At a hydraulic loading rate of 18.9 m/day a recycle ratio of 1.0 was found to optimize nitrification while increasing the recycle ratio to 3.0 did not improve filter performance. The results of the respirometer study verified that a salinity range of 3000 to 5000 mg/L TDS was optimum for nitrification under high salinity conditions. (Jacquez-NM St. U.)
W88-00723

SELECTING GENOTYPES OF VALENCIA PEANUTS FOR SALT TOLERANCE AND EFFICIENT SALINE WATER UTILIZATION,
New Mexico State Univ., Clovis. Agricultural Science Center.
D. C. Hsi.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-202198/AS. Price codes: A02 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 206, June 1986. 14 p, 1 tab, 30 ref. Project No. 1423613.

Descriptors: *Salt tolerance, *Genotypes, *Valencia peanuts, *New Mexico, Irrigated agriculture, Salinity, Screening, Biotechnology, High Plains.

More than one million acres of New Mexico's land area are irrigated annually for crop production. Fresh water scarcity, escalating energy costs for deep well pumping, and increasing population demands for fresh water have restricted the expansion of irrigated agriculture. Problems such as these have caused a decrease in irrigated acreage devoted to low value crops (per unit area), such as wheat and grain sorghum. Hydrological survey results indicate that New Mexico has an abundance of underground saline water (about 15 billion acre feet). Because of its high content of total dissolved solids, saline water cannot be used for industrial or domestic use, or for traditional irrigated agriculture. Desalinization is expensive and requires a large amount of energy. Agricultural scientists are selecting and breeding crops of economic importance to New Mexico that could produce under culture with high levels of salinity. This project describes such an attempt with Valencia peanuts, a relatively profitable crop under cultivation in the high plains of eastern New Mexico. Several hundred genotypes of world collections of Valencia peanuts have been collected and screened at levels of salinity that cause severe injury to commercially grown Valencia peanut cultivars. At seedling stage, plants of several accessions were greener, more vigorous and had higher dry weight than the standard cultivars. (HSI-Agr. Sc. CLat Los Lunas)
W88-00724

SOUTHWEST REGION SOLAR POND STUDY FOR THREE SITES - TULAROSA BASIN, MALAGA BEND, AND CANADIAN RIVER,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 3A.
W88-00781

3D. Conservation In Domestic and Municipal Use

FINANCIAL BURDENS AND ECONOMIC COSTS IN EXPANDING URBAN WATER SYSTEMS,
North Carolina Univ., Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6C.
W88-00025

POTABLE WATER REUSE,
Black and Veatch, Denver, CO.
For primary bibliographic entry see Field 5D.
W88-00172

DUAL WATER SYSTEMS IN WATER REUSE,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5D.
W88-00173

INCREASING EFFICIENCY OF NONAGRICULTURAL WATER USE,
J. E. Flack.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 133-156, 5 tab, 25 ref.

Descriptors: *Water conservation, *Agriculture, *Water demand, *Water supply, Irrigation, Water use, Conservation, Municipal water, Industrial water, Storm water, Water scarcity, Wastewater renovation, Water reuse, Urbanization, Recycling, Return flow, Water metering, Pricing, Water scarcity.

Increased efficiency in use of nonagricultural water can have a small but significantly important impact on water availability for irrigated agriculture in the West. Water used for commercial, industrial, and residential purposes is less than 5% of that used in agriculture and involves the most valued storage sites and earliest priority water rights. Conservation programs can slow the increasing municipal and industrial water demands. Some possible strategies are reuse of municipal wastewater, recycling, stormwater storage and use, reuse of industrial water, use of return flows, and decreasing urban water demand. Savings of one-third can be achieved by implementing metering, water-saving household devices, proper pricing, and use restrictions. (See also W88-00291) (Cassar-PTT)
W88-00297

GUIDE TO THE CONTROL OF WATER LOSSES IN PIPE NETWORKS,
Pretoria Univ. (South Africa). Div. of Water Utilization Engineering and Environmental Science.
F. A. Van Duuren, W. Koschade, and H. C. Chapman.
Report to South Africa Water Research Commission, Pretoria, (1978). 13 p, 1 fig, 9 tab, 48 ref.

Descriptors: *Water conservation, *Leakage, *Pipes, *Water loss, *South Africa, Water meters, Water distribution.

A research project on water losses in the distribution systems investigated water metering, pipe ma-

terials and construction methods, water losses at specific centers, leak detection methods, and leak prevention and control. Although new meters are generally accurate, a regular maintenance program, especially for bulk meters, is necessary to preserve accuracy. Meter accuracy helps indicate the degree of water loss, but it does not reduce losses. In South Africa specifications for materials and installation of pipes are satisfactory. However, actual handling, transportation, and installation should be better supervised in the field. Water losses at five South African cities were unrealistically low in some cases. This is attributed to inaccurate bulk meters. Visual, sounding, and waste detection meters are most successful in detecting leaks. In some of the networks losses due to slow consumer meters are extremely serious. Unmetered drawoffs are not significant. Reducing the water pressure in a test area from 1000 kPa to 400 kPa reduces the minimum night flow from 11,200 to 4800 L/hr. An unaccounted water loss of about 10% is considered acceptable. As losses reach 15%, a loss control program should be initiated. Suggestions for improving water loss control in the future include research on maximum and minimum pipe pressures and incorporation of leak detection equipment in new networks. (Cassar-PTT)
W88-00831

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN LIPSCOMBE COUNTY, TEXAS: PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, AND WELL YIELDS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W88-00937

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN HARTLEY COUNTY, TEXAS: PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W88-00940

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN DONLEY COUNTY TEXAS: PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,
For primary bibliographic entry see Field 2F.
W88-00941

3E. Conservation In Industry

MUNICIPAL WASTEWATER REUSE IN POWER PLANT COOLING SYSTEMS,
Water Purification Associates, Cambridge, MA.
For primary bibliographic entry see Field 5D.
W88-00184

PROBLEMS OF WATER REUSE IN COKE PRODUCTION,
Carnegie-Mellon Univ., Pittsburgh, PA.
For primary bibliographic entry see Field 5D.
W88-00186

INDUSTRIAL REUSE OF WASTEWATER: QUANTITY, QUALITY AND COST,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W88-00187

WASTEWATER REUSE IN THE FOOD PROCESSING INDUSTRY,
Esvelt Environmental Engineering, Spokane, WA.
For primary bibliographic entry see Field 5D.
W88-00189

PURIFICATION OF HYDROCARBON STREAMS,
Phillips Petroleum Co., Bartlesville, OK.
For primary bibliographic entry see Field 3C.
W88-00531

DISTRIBUTING THE RISKS OF INTERBASIN WATER TRANSFERS UNDER DROUGHT CONDITIONS: THE DILEMMA POSED BY COAL SLURRY PIPELINES (A SUMMARY VERSION),
Teknekron Research, Inc., Berkeley, CA.
For primary bibliographic entry see Field 6E.
W88-00539

DISTILLED WATER PRODUCTION DEVICE,
Yamamoto Scientific Co. Ltd., Tokyo (Japan).
For primary bibliographic entry see Field 5F.
W88-00572

STATUS REPORT ON ABATEMENT OF WATER POLLUTION FROM THE CANADIAN PULP AND PAPER INDUSTRY (1982).
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
For primary bibliographic entry see Field 5G.
W88-00676

FORMATION OF TOXAPHENE-LIKE CONTAMINANTS DURING SIMULATED PAPER PULP BLEACHING,
Illinois Univ. at Urbana-Champaign. Environmental Research Labs.
For primary bibliographic entry see Field 5D.
W88-00728

INCINERATION OF WATER POLLUTANTS WITH ACTIVATED CHAR FROM COAL, WOOD, OR CROP RESIDUES IN A SYSTEM DESIGNED TO PRODUCE ENERGY AND PYROLYSIS BYPRODUCT CHEMICALS,
Missouri Univ.-Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W88-00733

POTENTIAL CONSEQUENCES OF REJECT STREAM REPLACEMENT PROJECTS ON AQUATIC, TERRESTRIAL, AND RECREATION RESOURCES: VOLUME I, STUDY INTRODUCTION AND DESCRIPTION OF CANDIDATE PROJECTS.
Engineering-Science, Inc., Arcadia, CA.
For primary bibliographic entry see Field 3A.
W88-00813

BIOSORPTION/HEAVY METAL IONS FROM INDUSTRIAL/MINING WASTE WATERS,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 5D.
W88-00960

3F. Conservation In Agriculture

EXTERNAL EFFECTS OF IRRIGATORS' PUMPING DECISIONS, HIGH PLAINS AQUIFER,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 4B.
W88-00023

IRRIGATION CONTROL IN THE PRESENCE OF SALINITY: EXTENDED LINEAR QUADRATIC APPROACH,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W88-00027

EFFECT OF SOIL WATER HYSTERESIS ON SOLUTE MOVEMENT DURING INTERMITTENT LEACHING,
University of New England, Armidale (Australia). Dept. of Resource Engineering.
For primary bibliographic entry see Field 5B.
W88-00036

APPLICATION OF A CONCEPTUAL MODEL TO IRRIGATION WATER REQUIREMENT AND SALT TOLERANCE OF CROPS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
E. Bresler.
Soil Science Society of America Journal SSJD4, Vol. 51, No. 3, p 788-793, May-June 1987. 5 fig, 1 tab, 19 ref.

Descriptors: *Irrigation, *Crop water requirements, *Crop salt tolerance, *Crop yield, Conceptual model, Water quality, Water quantity, Model studies, Continuous irrigation, Theoretical models, Salt tolerance curves, Soil salinity, Wet irrigation, Dry irrigation.

A theoretical model describing crop yield response to water quantity and quality under irrigation conditions is generalized to obtain soil-water-salt regimes, water requirement, and salt tolerance curves. Theoretical results show that under continuous irrigation conditions steady water and salt regimes may be achieved only when application water quantities exceed seasonal class A pan evaporation by >50%. The effects of water quantity and soil salinity on crop yield and the shape of the response curves to electrical conductivity of saturated paste extracts were similar for measured data and simulated results. In both, salt tolerance curves of wet irrigation regimes had maximum relative yield of one, while for dry irrigation regimes had maximum relative yield <1.0. (Author's abstract)
W88-00107

WASTEWATER REUSE IN ARID AREAS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 5D.
W88-00170

MUNICIPAL WASTEWATER IN AGRICULTURE.
For primary bibliographic entry see Field 3C.
W88-00270

WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE.
For primary bibliographic entry see Field 6D.
W88-00291

IMPROVING CROP MANAGEMENT,
R. D. Lacewell, and G. S. Collins.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 180-203, 1 fig, 3 tab, 30 ref.

Descriptors: *Water conservation, *Agriculture, *Water use, *Water cost, Irrigation, Crop production, Water scarcity, Drought resistance, TEHCSIM model, Water management.

Rising costs and increasing scarcity of agricultural water require adjustment of cropping patterns. Several options are possible: a shift to higher-value crops (vegetables, citrus, grapes, nuts), a shift to drought-resistant crops (guayule, jojoba, crambe, buffalo gourd), or a change in production systems to improve yields and decrease costs. Estimates obtained with the TECHSIM model show that doubling irrigation costs in the U.S. produces only a slight change in cropping patterns. The major effect is a reduction in net farm income in the West, exceeding 20% for many states. High-value crops are not likely to become prominent. Rather, farmers are expected to use new technology with more familiar field crops. Crop rotation, residue management, and tillage practices can be adjusted to provide maximum crop yield with minimum water use. Other water saving techniques include low-energy precision application (sprinkler system with drop tubes), furrow dikes, and limited irrigation-dryland system (one-half irrigated, the next

fourth receiving runoff, and the last fourth managed as dryland). (See also W88-00291) (Cassar-PTT)
W88-00299

IMPROVING LAND AND WATER USE PRACTICES,
N. J. Rosenberg.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 204-217, 39 ref.

Descriptors: *Water conservation, *Agriculture, *Water supply, Water management, Water harvest, Snow management, Evapotranspiration, Albedo, Shelterbelts, Windbreaks, Drought resistance, Reflectance, Water use, Land use.

To sustain dryland agriculture in the semiarid and subhuman West, the supply of available water must be increased and water conservation must be implemented. Among the proven techniques for increasing the supply are water harvesting, minimum tillage, snow management, improved cultural practices, and soil evaporation reduction. Methods of decreasing demand include practices, and soil evaporation reduction. Methods of decreasing demand including planting drought-tolerant crops; and modifying the microclimate with windbreaks, shelterbelts, and reflectants. Plants with improved moisture stress may also be bred. Artificial reflectants are somewhat impractical. However, certain varieties of plants have increased albedo and thus less evapotranspiration. (See also W88-00291) (Cassar-PTT)
W88-00300

IMPROVING IRRIGATION SYSTEMS,
M. E. Jensen.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 218-243, 2 fig, 5 tab, 12 ref.

Descriptors: *Water conservation, *Irrigation efficiency, *Agriculture, *Water supply, Water scarcity, Diversion, Water conveyance, Return flow.

In the U.S. in 1975 217 cu km of water were withdrawn for irrigation, 118 cu km were consumed. About 93% of the water consumed was by irrigation in the western U.S. Two hypothetical case examples show the complexity of irrigation systems and the difficulty of estimating the probable impacts of proposed system changes on available water to agriculture. Case 1 is an upstream project along a major river. Major changes in the conveyance and on-farm systems may have little effect on net water available to agriculture if a high proportion of the excess water returns to the river system. If more land is irrigated with increased water supplies, water consumption is essentially transferred upstream from downstream areas. Case 2 is a project near the downstream end of a river basin, near the ocean or salt sink. Here, large increases in water supply for agriculture can be obtained if return flow systems are made part of the on-farm surface irrigation systems and the irrigated area is enlarged or diversions are reduced. In the western states it is estimated that massive changes in irrigation systems would provide less than 4% more water for agriculture. (See also W88-00291) (Cassar-PTT)
W88-00301

WHAT FARMERS CAN DO FOR THEMSELVES,
C. Miller, and B. P. Cardon.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 380-395, 3 tab, 10 ref.

Descriptors: *Water conservation, *Water supply, *Agriculture, Irrigation, Farm management, Conservation, Water scarcity, Water management, Sprinkler irrigation, Drip irrigation, Irrigation efficiency, Hydroponics, Impaired water use, Costs.

Irrigation costs on some western farms are approaching half the total costs of production. These high and increasing water costs, plus some states' new laws about water rights, are forcing steps by individual farmers to conserve water. However, conservation measures must themselves be economical in order for farmers to adopt them, and many of the measures are expensive investments. The solutions for farmers are (1) new irrigation technologies such as laser-leveling and drip systems; (2) management for high water efficiency in scheduling, crop choices, and other variables; and (3) support for desirable developments in the private and government sectors, such as inverse utility pricing, funding for research, and cost-sharing programs. (See also W88-00291) (Author's abstract)
W88-00308

POTENTIAL COST SAVINGS FROM INVESTMENTS IN ENERGY-CONSERVING IRRIGATION SYSTEMS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 6C.
W88-00478

1981 ANNUAL REPORT OF THE COOLIDGE SOLAR IRRIGATION PROJECT,
Sandia National Labs., Albuquerque, NM.
L. Torkelson, and D. L. Larson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001853. Price codes: A07 in paper copy, A01 in microfiche. Sand-82-0521, June 1982. 128 p, 71 fig, 53 tab, 3 ref.

Descriptors: *Water conservation, *Irrigation, *Solar energy, *Electric power, Conservation, Coolidge Solar Irrigation Project, Arizona.

The second year of operation of the Coolidge, Arizona, Solar Irrigation Project is summarized. This facility consists of 2140.5 sq m of parabolic trough collectors arranged in eight loops having a north-south orientation and three heat transfer loops. Electrical energy generation varied from about 1 Mwhe in December 1980 to 20-25 Mwhe during each of the summer months, 1981. Total electrical energy generated during the fiscal year was 160,000 kWhe. In spring of 1981 the Coilzak reflector panels were replaced with FEK-244 reflector panels, but expected system performance improvements were not realized. The reflectors are being adjusted more accurately as time permits. Overall system efficiency and operation do not vary with collector field outlet temperature over the range of 266 to 288 C, showing that a tight control of the field outlet temperature is not necessary for this type of system. (Cassar-PTT)
W88-00479

ENERGY USE IN IRRIGATION AND THE POTENTIAL FOR ENERGY SAVINGS BY APPLICATION OF ENERGY-SAVING TECHNOLOGIES,
Battelle Pacific Northwest Labs., Richland, WA.
M. A. Clark, W. P. Patton, and G. L. Wilfert.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-002030. Price codes: A02 in paper copy, A01 in microfiche. PNL-SA--9866, August 1981. 11 p, 7 tab. Contract No. DE-AC06-76RLO 1830.

Descriptors: *Irrigation, *Irrigation design, *Irrigation efficiency, Irrigation practices, Energy, Economic aspects, Wells, Groundwater.

The findings of a study to assess the cost saving and market penetration of the energy conserving technologies are presented. The analyses performed in the study include the estimation of total quantity of energy consumed annually by irrigated agriculture; evaluation of the technical potential for energy-conserving systems when compared with conventional systems; analysis of economic potential for energy conserving systems to reduce irrigation expenses relative to conventional systems; and estimation, based on market penetration potential, of the maximum quantity of energy that could be saved annually if energy conserving systems are substituted for conventional systems where it is cost-effective to do so. Energy saving irrigation technologies discussed include low-pressure center pivot sprinklers, low-energy precision application, automated gated pipe, well development and drilling, pump design, variable speed pump, computerized scheduling, instrumental scheduling, groundwater system optimization, and optimal pipe network design. (Halterman-PTT)
W88-00489

ASSESSMENT OF SELECTED LEGAL/INSTITUTIONAL CONSTRAINTS TO WATER CONSERVATION IN THE WESTERN STATES (A SUMMARY VERSION),
Teknekron Research, Inc., Berkeley, CA.
For primary bibliographic entry see Field 6E.
W88-00538

RECYCLING OF SEWAGE EFFLUENT BY SUGARCANE IRRIGATION: A DILUTION STUDY, OCTOBER 1976 TO OCTOBER 1978, PHASE II-A,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
L. S. Lau, P. C. Ekern, P. C. Loh, R. H. Young, and G. L. Dugan.
Technical Report No. 130, March 1980. 107 p, 3 fig, 21 tab, 39 ref, 6 append.

Descriptors: *Water reuse, *Fate of pollutants, *Wastewater irrigation, *Irrigation, *Sugarcane, Nitrates, Agriculture, Furrow irrigation, Viruses, Hawaii.

Chlorinated secondary sewage effluent, diluted with ditch water, was used for furrow irrigation of sugarcane. The five irrigation treatments for the 2-year cane cycle were (1) ditch water, (2) 12.5% effluent, (3) 25% effluent, (4) 50% effluent, and (5) effluent the first year and ditch water the second year. Sugar yields for effluent concentrations up to 25%, or for effluent the first year and ditch water the second year, were equal to those from conventional ditch water irrigation. At 50% effluent, juice quality and sugar yield were significantly less. The irrigation was equivalent to an annual average of about 2.03 m/year. This corresponded to 680,000 sq m for each 0.04 cu m/sec of undiluted output from the wastewater treatment plant. Immediately after application of fertilizer and with effluent concentrations 50% and greater, nitrate nitrogen concentrations in the percolate exceeded 10 ppm. About 55% of the irrigation water percolated beyond the root zone. No virus was recovered from the test plots. At least 96% of the virus was inactivated after one day's storage. (Cassar-PTT)
W88-00559

COST OF WATER IN WESTERN AGRICULTURE,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
D. L. Wilson, and H. W. Ayer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152686. Price codes: A02 in paper copy, A01 in microfiche. ERS Staff Report No AGES820706, August 1982. 16 p, 8 tab, 20 ref.

Descriptors: *Water costs, *Irrigation water, *Water allocation, Costs, User charges, Irrigation, Irrigation practices.

A large portion of the irrigated West has what may be considered inexpensive water--$20 per acre-foot or less. Therefore, efforts to obtain water conservation through reduced per acre applications are not likely to be economical in many of these areas. With low cost water, less efficient flood and siphon irrigation systems predominate. In areas with higher water costs, more efficient gated pipe and sprinkler systems are the most common. Nearly 80% of the water provided by the Bureau of Reclamation costs $15 per acre-foot or less. A restructuring of these contractual water prices would encourage farm operations to invest in more water conserving practices and shift from irrigated forage to irrigated food crops and feed grains. (Author's abstract)
W88-00638

WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE.
For primary bibliographic entry see Field 6D.
W88-00650

CRITERIA FOR THE IDENTIFICATION OF POTENTIAL SITES FOR IRRIGATION WITH SALINE WATERS IN NEW MEXICO,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W88-00720

OPTIMIZATION OF IRRIGATION SCHEDULING WITH ALTERNATIVE SALINE WATER SUPPLIES IN THE ROSWELL - ARTESIA BASIN, 1985,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Economics and Agricultural Business.
For primary bibliographic entry see Field 3C.
W88-00722

ECONOMIC DIFFERENCES BETWEEN CUMULATIVE AND EPISODIC REDUCTION OF SEDIMENT FROM CROPLAND,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2J.
W88-00729

COLUMBIA BASIN WILDLIFE/IRRIGATION DEVELOPMENT STUDY,
Washington State Dept. of Game, Ephrata.
For primary bibliographic entry see Field 6G.
W88-00784

GARRISON DIVISION UNIT COMMISSION, SUPPLEMENT TO INTERIM STAFF REPORT ON ISSUES AND ALTERNATIVES.
Garrison Diversion Unit Commission, Bismarck, ND.
For primary bibliographic entry see Field 6G.
W88-00785

GARRISON DIVERSION UNIT COMMISSION, PRELIMINARY FINAL REPORT.
Garrison Diversion Unit Commission, Bismarck, ND.
For primary bibliographic entry see Field 6G.
W88-00795

GARRISON DIVERSION UNIT COMMISSION, FINAL REPORT.
Garrison Diversion Unit Commission, Bismarck, ND.
For primary bibliographic entry see Field 6B.
W88-00830

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FLOWS FROM A CLAY SOIL - SEASONAL CHANGES AND THE EFFECT OF MOLE DRAINAGE,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2G.
W88-00009

SCREENING TACTICS IN A WATER MANAGEMENT POLICY ANALYSIS FOR THE NETHERLANDS,
RAND Corp., Santa Monica, CA.
For primary bibliographic entry see Field 6B.
W88-00026

NEW METHOD FOR THE REAL-TIME OPERATION OF RESERVOIR SYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
A. P. Georgakakos, and D. H. Marks.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1376-1390, July 1987. 6 fig, 5 tab, 40 ref.

Descriptors: *Statistics, *Stochastic hydrology, *Reservoir operation, *Multireservoir networks, *Water management, *Model studies, *Data interpretation, Mathematical equations, Mathematical studies, Mathematical models, Differential equations, River dynamics, Rivers, Reservoir systems, High Aswan Dam.

In new method for the real-time operation of reservoir systems the system is represented by a set of stochastic differential equations describing the reservoir and river dynamics in state space form. The formulated reservoir operation problem calls for finding policies which maximize the expected benefits of one system's objective while satisfying the remaining objectives at prespecified reliability levels. The solution is obtained by a new method named extended linear quadratic Gaussian (ELQG) controller. ELQG draws on and extends stochastic control theory results, and is well suited for the optimization of constrained dynamical systems. It is a trajectory iteration algorithm theoretically expected to exhibit reliability and computational efficiency. The method was tested in several computational experiments for the control of the High Aswan Dam. The problem was to maximize expected energy generation subject to release and storage reliability constraints imposed from operational requirements. ELQG displayed reliability and computational efficiency even for very long control horizons. (Wood-PTT)
W88-00046

RECORDING FATHOMETER TECHNIQUES FOR HYDRILLA DISTRIBUTION AND BIOMASS STUDIES,
Florida Univ., Gainesville. Aquatic Plants Research Center.
For primary bibliographic entry see Field 2H.
W88-00466

ENVIRONMENTAL FEATURES FOR STREAMBANK PROTECTION PROJECTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2J.
W88-00468

DRAINAGE SYSTEM,
For primary bibliographic entry see Field 5E.
W88-00498

IMPOUNDMENT AND DIVERSION SYSTEMS FOR PREVENTING OR MITIGATING FLOODING,
D. A. Laesch.
U.S. Patent No. 4,457,646; July 3, 1984. 11 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1044, No 1, p 244, July 3, 1984.

Descriptors: *Patents, *Flood control, *Flooding, *Urban drainage, *Reservoirs, *Diversion ditches, Flooding protection, Drainage engineering, Drainage systems, Diversion channels, Sewers, Creeks.

A reservoir impounds water from a drainage facility to prevent or mitigate flooding, particularly in urban communities. The water is diverted to the reservoir for temporary storage in response to abnormal volumetric water flow in the drainage facility. The temporarily stored water is returned to the drainage facility after the volumetric flow returns to normal. The diversion system may include various conduits between the reservoir and the drainage facility and, in the case of a creek, also includes a wall constructed across the creek to limit the flow. (Cremmins-AEPCO)
W88-00503

METHOD FOR MINING AND RECLAIMING LAND,
A. K. Zurcher, and W. F. McFarland.
U.S. Patent No. 4,462,713; July 31, 1984. 13 p, 3 fig, 1 tab. Official Gazette of the United States Patent Office, Vol 1044, No 5, p 2001, July 31, 1984.

Descriptors: *Patents, *Drainage engineering, *Pipes, *Mining engineering, *Land reclamation, *Saline soils, *Agricultural engineering, Seeps, Water treatment, Percolation, Saline water, Cultivated lands.

A subterranean drain pipe is installed to collect water for mining and reclaiming land. The salinity of the soil at the site of the drain pipe is measured periodically to determine the feasibility of simultaneous crop production with the collection and purification of the water. Subterranean water is collected from a recharge area and percolated waters from a swale or discharge area. Dissolved salts and minerals are mined from the collected water through chemical and physical treatments before it is either discharged into the river or returned back to the surface of the land for topical application. It is applied at either the recharge or discharge area to allow further circulation and percolation through the land to dissolve and remove additional soluble salts and minerals. (Cremmins-AEPCO)
W88-00504

PROCEDURE FOR ESTIMATING FLOW-DURATION CURVES FOR UNGAGED MOUNTAINOUS AND HIGH PLAINS STREAMS IN MONTANA,
Montana State Univ., Bozeman. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-00550

METHOD AND APPARATUS FOR IMPEDING SEDIMENT DEPOSITION IN HARBORS AND NAVIGATION CHANNELS,
California Univ., Berkeley. Regents.
For primary bibliographic entry see Field 8H.
W88-00586

CONTROL METHOD FOR OPEN CHANNEL,
Hitachi Ltd., Tokyo (Japan).
F. Wakamori, T. Noma, M. Adachi, M. Funabashi, and M. Suzuki.
U.S. Patent No. 4,522,534; June 11, 1985. 7 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1055, No 2, p 707-708, June 11, 1985.

Descriptors: *Patents, *Control systems, *Flow discharge, *Open channels, *Water supply, *Flow control, Open-channel flow, Mathematical models, Water tanks, Water conveyance.

Water flow through an open channel is controlled using a method in which the need for calculation of transient changes caused by fluctuations in water demand is reduced. The control system comprises a gate for opening and closing the open channel, a technique for estimating values of state parameters in reaches into which the open channel is divided by the gate, and units to control the degree of the gate based on the estimated state parameters. A water tank model in which three theoretical water tanks are connected in series is used for representing the transient condition of an open channel and six variables including liquid levels of three imaginary water tanks, flow rates of water flowing through passages in two imaginary conduits, and a flow rate of diverted water. The liquid levels of the upstream and downstream imaginary water tanks are observable, so that the transient condition of the open channel can be obtained with a high degree of precision. (Cremmins-AEPCO)
W88-00591

FLOW REGULATION DEVICE FOR WASTE WATERS,
For primary bibliographic entry see Field 5D.
W88-00596

AQUATIC WEED BARRIER,
Du Pont Canada, Inc., Mississauga (Ontario).
E. L. Fletcher.
U.S. Patent No. 4,518,280; May 21, 1985. 5 p, 11 fig. Official Gazette of the United States Patent Office, Vol 1054, No 3, p 1197-1198, May 21, 1985.

Descriptors: *Patents, *Aquatic weed control, *Barriers, *Water quality control, Polymers, Flow discharge, Thin films.

A film made of thermoplastic synthetic polymer is applied to prevent the growth of aquatic weeds. The film, which contains incisions that are shaped to form flaps, has a light transmittance of 200 to 650 nm. The flaps adjacent to each incision are about 1 and 25 sq cm. In other forms, there are about 36 incisions and 1 incision per sq meter of film; or each incision is V-shaped, forms a triangular flap, and has flaps of between 1 and 25 sq cm. In another form, the thermoplastic synthetic polymer is selected from the group consisting of nylon, monopolymers and copolymer of C2-C3 olefins, polyesters and polyvinylchloride. (Cremmins-AEPCO)
W88-00607

BEACH EROSION PREVENTION JETTY CONFIGURATION,
For primary bibliographic entry see Field 4D.
W88-00608

LIGHTWEIGHT SEMI-FLEXIBLE DIKE,
Shell Offshore, Inc., Houston, TX.
For primary bibliographic entry see Field 4D.
W88-00609

FLUID WAVE ENERGY DISSIPATING AND ABSORBING STRUCTURE,
For primary bibliographic entry see Field 4D.
W88-00610

FLOOD DISASTER CONTROL BAG,
D. R. Wagner, and G. Spector.
U.S. Patent No. 4,362,433; December 7, 1982. 3 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1025, No 1, p 185, December 7, 1982.

Descriptors: *Patents, *Flood control, *Flood protection, *Barriers, *Levees, *Dikes, Embankments, Sands, Floodproofing, Floodwater, Safety.

A flood control bag filled with river water forms levees or dikes to protect against floodwaters. The bag is fiber woven and includes a waterproof or sand liner; rings and clips at corners allowing bags to be locked together, a water filler opening at one end, and fiber handles for each side of the opening for easy handling, including those forms of the bag that are partially filled with sand. The flood control bags are also useful for control of crowds, vehicle traffic, and chemical spills. (Cremmins-AEPCO)
W88-00611

SELF-ACTUATING WATER CONTAINMENT BARRIER,
C. B. Goodstein.
U.S. Patent No. 4,377,352; March 22, 1983. 4 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1028, No 4, p 793-794, March 22, 1983.

Descriptors: *Patents, *Barriers, *Flow discharge, *Flow control, *Water control, Tidal bores, Water level, Flood control, Trapping, Tidewater.

A water containment barrier for controlling and recycling water flow comprises a self-movable stanchion, which is raised and lowered with and by respective changes in water level. A series of such stanchions are mounted and interconnected with sheeting to form a barrier which can contour a particular land mass. The barrier can be used to control flood waters, or for incoming tides and bores, as well as in estuaries for trapping water. When the water recedes to a low level and the stanchion is lowered to a horizontal position, the stanchions are protected from damage by wind, storms, and tornadoes. They are also aesthetically acceptable to the landscape. (Cremmins-AEPCO)
W88-00612

ORGANISMS IMPACTING WATERHYACINTH IN THE PANAMA CANAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. R. Sander, R. F. Theriot, and E. A. Theriot.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA 114401. Price codes: A03 in paper copy, A01 in microfiche. Miscellaneous Paper A-82-1, February 1982. Final Report. 45 p, 11 fig, 9 tab, 7 ref.

Descriptors: *Aquatic weed control, *Weed control, *Water hyacinth, *Panama Canal, Pathogens, Biocontrol, Insects, Neochetina, Cornops, Orthogalumna terebrantis, Acremonium zonatum.

As part of the overall aquatic plant control assistance program provided to the Panama Canal commission by the U.S. Army Engineer Waterways Experiment Station, a study was initiated in 1978 to determine the complement of organisms impacting water hyacinth in the Panama Canal. Results of the study were to provide a basis for recommendations for the introduction of other species for the biocontrol of water hyacinth. Six sites were selected and twenty-four water hyacinth plants from each site on each sampling date were examined during 1978-80 for the presence of arthropods and plant pathogens. Three arthropod species, Neochetina eichhorniae Warner, Cornops sp. Bruner, and Orthogalumna terebrantis Wallwork, were abundant on all but two sites on all sampling dates. Orthogalumna terebrantis was rare on two of the sites, which indicated a need for an effort to distribute this species to all areas of the Canal. One plant pathogen, Acremonium zonatum (Saw.) Gams, was abundant on all sites on all sampling dates. None of the species found on water hyacinth in the canal exerted significant pressure on the growing points of the plants. Consequently, it was recommended that additional species be introduced into the Canal for the biocontrol of water hyacinth with top priority given to those species (e.g., Sameodes albiguttalis (Warren)) that feed on the newest tissues of the plant. Other species that should be considered for introduction include one plant pathogen, Cercospora rodmanii Conway, and two insect species, Arzama densa Walker and Neochetina bruchi Hustache. (Author's abstract)
W88-00681

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS, REPORT 1: BASELINE STUDIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
E. C. Blancher, and E. G. Buglewicz.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA 102744. Price codes: A06 in paper copy, A01 in microfiche. Volume VIII: Summary of Baseline Studies and Data, Technical Report A-78-2, May 1982. Report 1 of a Series. 51 p, 17 fig, 2 tab, 22 ref, append.

Descriptors: *Lakes, *Aquatic weed control, *Baseline studies, *Aquatic life, Weed control, White amur, Biocontrol, Aquatic habitats, Reptiles, Amphibians, Mammals, Wildlife, Fish, Invertebrates, Lake Conway, Florida, Waterfowl, Algae, Plankton, Phytoplankton, Zooplankton, Ecosystems, Nutrients, Nitrogen, Phosphorus, Sediments.

This summary of baseline conditions in Lake Conway, Florida, covers the period January 1976 to August 1977 prior to release of white amur for aquatic weed control in September 1977. No larger surface streams drain into the lake. Rainfall provides 70% of incoming water; seepage (17%) and surface runoff (13%) the remainder. Rainfall and dry deposition contribute 71% of nitrogen and 52% of phosphorus loading; surface runoff, 6.9% of N and 36.9% of phosphorus loading; subsurface seepage, 19% of N and 8% of phosphorus loading. The main nutrient sink is sedimentation. Phosphorus limits primary production in the lake during part of the year; no nitrogen limitation is observed. Presently mesotrophic, the lake could become eutrophic with urban development. Water quality, plankton, periphyton, and benthos are typical of a mesotrophic Florida lake, that is reasonably diverse. Periodic blue-green algal blooms, decrease in macroinvertebrate diversity during summer anoxia, and nuisance growth of periphyton point to a eutrophic direction. Dominant submerged macrophytes are hydrilla, nitella, pondweed, and eelgrass. Fish, waterfowl, and aquatic mammals are all typical of a central Florida lake. Eleven species of amphibians and 16 species of reptiles were observed or captured during the survey. (Cassar-PTT)
W88-00682

FLOOD WATER CONTAINMENT BAG,
American Threshold Industries, Inc., Ashville, NC.
R. T. Bayer.
U.S. Patent No. 4,650,368; March 17, 1987. 5 p, 3 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1076, No 3, p 1442, March 17, 1987.

Descriptors: *Patents, *Flood protection, *Flood control, *Porous media, *Barriers, Flooding, Flood water, Water control, Levees, Dikes.

Containment bags form a flood water containment barrier, wall, levee, or dike. The bags are constructed to enable the interior of the bag to be permeated by moisture. The interior also includes a water absorbent material which substantially expands in volume when wetted. The flattened bags are positioned to form a containment barrier or wall when the flood water permeates the bag and increases the volume so that the bags will assume a maximum volume. Fastener strips are attached to top and bottom surfaces of the horizontally arranged bags to enable them to be interconnected to stabilize the formed barrier. (Cremmins-AEPCO)
W88-00760

GREAT LAKES DIVERSION AND CONSUMPTIVE USES: A REPORT TO THE UNITED STATES AND CANADA UNDER THE 1977 REFERENCE.
International Joint Commission-United States and Canada, Windsor (Ontario).
January 1985. 82 p, 7 fig, 14 tab, 7 append.

Descriptors: *Great Lakes, *Water use, *Water management, *Diversion, Consumptive use, Waterways, Inland waterways, Legal aspects, Diversion losses, Projections, Future planning.

The International Joint Commission reports on the existing diversions of Great Lakes water, and the existing and projected consumptive uses in the Great Lakes basin. This report addresses matters that warrant the attention of appropriate jurisdiction in the United States and Canada, and makes recommendations for addressing future considerations regarding the use of Great Lakes water. The web of activities supported by the supply of water throughout the Great Lakes basin is described, and the effects of water quality and water quantity on these activities are discussed in general terms. In addition, the history and effects of several existing diversions are discussed in detail. The diversions discussed are into Lake Superior from Long Lac and Ogoki, out of Lake Michigan at Chicago, between Lakes Erie and Ontario at the Welland Canal, and between the Niagra River and Lake Ontario through the New York Barge Canal system. The 1975 withdrawal and consumptive use figures are given, and are broken down both by water use sector and by lake. Projected withdrawal and consumptive figures for the year 2000 are also given, and some guidelines for future decisions to be made by the United States and Canada regarding Great Lakes use are outlined. (Halterman-PTT)
W88-00802

RADIOTELEMETRY TRACKING AT LAKE CONWAY, FLORIDA,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. P. Keown, and R. M. Russell.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-118694. Price codes: A05 in paper copy, A01 in microfiche. Technical Report A-82-4, August 1982. Final Report. 73 p, 31 fig, 15 ref, 2 append.

Descriptors: *Aquatic weed control, *Telemetry, *Biocontrol, *Lakes, White amur, Remote sensing, Aquatic habitats, Lake Conway, Florida, Weed control, Fish behavior, Reptiles, Tracking techniques.

White amur, introduced into Lake Conway, Florida, as a biocontrol for aquatic weeds, were radiotagged and tracked. In 1,484 observations between May 1979 and October 1980 radiotagged amur were present in vegetated areas over 90% of the time, except for August (65% of the time) and September (58% of the time). During the same time divers observed progressive clearing of aquatic plants where amur were concentrating. Radiotagged fish were often seen swimming with schools of about 30 untagged fish, showing that movements of tagged fish and untagged fish were similar. About 75 representative members of the herpetofauna were similarly tagged and observed. Chrysemys and stinkpot turtles traveled over large distances, sometimes >1 km in a day or two. Adult Chrysemys were found most of the time in open water and rarely in the shallows. Mud turtles generally stayed within a 10 m x 10 m area. The accuracy of depth estimates was better with the receiving antenna under water than with the receiving antenna above the water surface. (Cassar-PTT)
W88-00837

LAKE PONTCHARTRAIN AND VICINITY HURRICANE PROTECTION PLAN, REPORT 2: PHYSICAL AND NUMERICAL MODEL INVESTIGATION OF CONTROL STRUCTURES AND THE SEABROOK LOCK; HYDRAULIC AND MATHEMATICAL MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W88-00857

UTILIZATION OF SURFACE MINE PONDS IN EAST TENNESSEE BY BREEDING AMPHIBIANS,
Tennessee Valley Authority, Norris. Div. of Land and Forest Resources.
L. J. Turner, and D. K. Fowler.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-145003. Price codes: A02 in paper copy, A01 in microfiche. Report FWS/OBS-81-08, June 1981. 13 p, 9 fig, 5tab, 23 ref. Contract No. 14-16-0009-78-708.

Descriptors: *Mine drainage, *Sedimentation basins, *Sedimentation ponds, Tennessee, Amphibians, Frogs, Salamanders, Toads, Aquatic plants, Water birds, Waterfowl, Hydrogen ion concentration.

Sediment control ponds are routinely removed from mine sites following cessation of mining activity because they are thought to have little value to fish and wildlife due to their acidity and small size. This study was conducted to examine the biological importance of surface mine ponds in one portion of the Appalachian coal field by (1) inventorying the amphibian fauna occurring in the ponds, (2) measuring selected water quality parameters, (3) collecting and identifying aquatic vegetation, and (4) observing general wildlife use of the surface mine pond habitat. Of the 24 ponds examined on Ollis Creek Surface Mine, Campbell County, Tennessee, 21 contained breeding amphibians and 20 produced aquatic vegetation. Aquatic insects and a diverse wildlife fauna utilized the study ponds. Large mammals (3 species), waterbirds (17 species), and snakes (2 species) were among those species observed. It was concluded that surface mine ponds supply an important habitat component for a variety of wildlife species, and that in some areas, they are the only source of surface water available for wildlife use. (Halterman-PTT)
W88-00898

PROTECTING INSTREAM FLOWS IN IDAHO: AN ADMINISTRATIVE CASE STUDY,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
S. W. Olive.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-169490. Price codes: A03 in paper copy, A01 in microfiche. Report FWS/OBS-82/35, September 1981. Instream Flow Information. Paper 15. 30 p, 34 ref.

Descriptors: *Water law, *Water policy, *Idaho, *Instream flow, *Administrative decisions, Decision making, Case studies, Water management, Environmental protection, Management planning, Water allocation, Water resources development.

This report is the third in a series depicting how particular states have protected instream uses of water. This paper discusses Idaho's system, which protects instream uses of water by appropriating flows for certain segments of rivers and streams. The appropriation water right means that an individual can divert and use water on lands that are not riparian to the river or stream if no harm is done to prior appropriations. An analysis of Idaho's governmental decisions about water allocation is also provided. The combination of models applied to the decision making process in Idaho involves: incrementalism, organizational processes, and mutual adjustment. Groups and individuals interested in establishing a system that protects instream flows should analyze the situation in their area before formulating plans. The first step in this analysis is to identify objectives. The second step in the analysis is to reveal opportunities that allow for the achievement of objectives. The third step is to identify the agencies and interest groups involved in policy formulation. The fourth step is to discover the roles and needs of the various agencies and groups. The fifth and final step is the formulation of a strategy or a set of strategies. Through the use of the scoping process, as well as a review of the instream flow practices in other states, groups and individuals will have a better chance to protect instream flows. (Geiger-PTT)
W88-00902

4B. Groundwater Management

LOCAL EFFECTS OF GROUNDWATER PUMPAGE WITHIN A FAULT-INFLUENCED GROUNDWATER BASIN, ASH MEADOWS, NYE COUNTY, NEVADA, U.S.A.,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2F.
W88-00008

EFFECT IF WATER-LEVEL RECOVERIES ON FAULT CREEP, HOUSTON, TEXAS,
Geological Survey, Menlo Park, CA.
T. L. Holzer, and R. K. Gabrysch.
Ground Water GRWAAP, Vol. 25, No. 4, p 392-397, July-August 1987. 5 fig, 2 tab, 20 ref.

Descriptors: *Groundwater management, *Water level, *Land subsidence, *Fault creep, *Geologic fractures, *Groundwater level, Groundwater depletion, Water management, Pumping, Groundwater recession, Houston, Texas, Aquifers, Seasonal variation.

Fault creep has stopped or slowed in the eastern part of the Houston, Texas, land subsidence area where reductions in pumping of groundwater have allowed water levels to recover partially. Creep has continued across faults in the western part where heavy pumping causes water levels to continue to decline. The observations support the long-suspected relation between historical faulting and withdrawal of groundwater and indicate that partial water-level recoveries can reduce fault movement and structural damage. Correlations between seasonal fault creep and seasonal groundwater fluctuations are presented to provide further support to the relationship. (Wood-PTT)
W88-00012

BENEFICIAL ASPECTS OF SEA-WATER INTRUSION,
Scarborough Coll., Westhill (Ontario).
K. W. F. Howard.
Ground Water GRWAAP, Vol. 25, No. 4, p 398-406, July-August 1987. 11 fig, 2 tab, 7 ref.

Descriptors: *Groundwater level, *Coastal aquifers, *Saline water intrusion, *Model studies, *Data interpretation, Prediction, Groundwater management, England, Water level, Saline water, Groundwater recession, Resources management, Aquifers, Potentiometric level, Groundwater recharge, Water quality.

The Permo-Triassic sandstone aquifer of northwest England has supplied groundwater since the early 19th century. Between Liverpool and Manchester, groundwater resource development resulted in a considerable lowering of the water level inland and intrusion of sea water from the Mersey Estuary and Manchester Ship Canal. As part of a detailed investigation of resource management, a two-dimensional finite-difference flow model was developed to represent aquifer behavior for the period 1840 to 1980. Subsequently, this model was used to predict the effects of implementing various management strategies over a 40-year period ending in 2020. Results indicate that groundwater withdrawals exceeded natural replenishment by an average of 100% during the past 50 years. In this time the potentiometric heads responded remarkably slowly to the flow imbalance, a resilience that is largely attributed to the inflow of sea water at rates only marginally less than recharge from meteoric sources. Careful development of the fresh groundwater resources minimized water quality problems along the estuary and ship canal. The model clearly shows how controlled inflow of saline water can enhance the recovery of fresh groundwater reserves considerably. Difficulties arise only when excessive exploitation accelerates water quality deterioration. Model calculations indicate that inflow of saline water would continue for over 10 years following complete cessation of fresh groundwater production. (Author's abstract)
W88-00013

VOCS IN GROUND WATER INFLUENCED BY LARGE SCALE WITHDRAWALS,
Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources.
For primary bibliographic entry see Field 5B.
W88-00014

INTERFACE UPCONING DUE TO A HORIZONTAL WELL IN UNCONFINED AQUIFER,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
A. Das Gupta, and V. P. Gaikwad.
Ground Water GRWAAP, Vol. 25, No. 4, p 466-474, July-August 1987. 5 fig, 2 tab, 23 ref.

Descriptors: *Upconing, *Saline-freshwater interfaces, *Coastal aquifers, *Wells, *Aquifers, *Groundwater, *Saline water, *Mathematical models, *Data interpretation, Model studies, Prediction, Mathematical equations, Mathematical studies, Dupuit assumption, Ghyben-Herzberg approximation, Boundary conditions, Seashores, Seawater, Comparison studies.

A simplified mathematical model was developed to predict the equilibrium location of upconed interface due to a horizontal well in an unconfined coastal aquifer of finite thickness. The model is based on Dupuit assumptions and Ghyben-Herzberg approximation with modified boundary conditions along the shoreline deduced from available analytical solutions. For a specified natural flow condition, the amount of fresh-water discharge to the sea as well as interface profile and length of intrusion can be determined. With the specification of the permissible extent of upconing from the natural interface location at any section, the model

provides an estimate of the amount of water that can be withdrawn by a horizontal well, the upconed interface profile, and the additional length of intrusion. The computed interface profile for the natural flow condition was in good agreement with the results of available analytical solutions. Comparison with the laboratory tests for the upconing case indicates that the simplified model provides a reasonable approximation of the interface profile for assessment of water withdrawal from a coastal aquifer at the initial stage of planning. (Author's abstract)
W88-00020

EXTERNAL EFFECTS OF IRRIGATORS' PUMPING DECISIONS, HIGH PLAINS AQUIFER,
Geological Survey, Reston, VA.
W. M. Alley, and J. E. Schefter.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1123-1130, July 1987. 7 fig, 1 tab, 18 ref, 2 append.

Descriptors: *Irrigation effects, *Pumping, *Groundwater management, *Groundwater level, *High Plains aquifer, Groundwater recession, Groundwater movement, Aquifers, Irrigation, Pumpage.

The High Plains aquifer, which underlies about 174,000 square miles (1 square mile = 2.59 sq km) in the Great Plains, is the principal source of water in one of the nation's major agricultural areas. Relationships between the scale of management areas and physical factors, resulting from the lateral movement of groundwater, that limit the ability of irrigators in the High Plains to reduce their own future pumping lifts were examined. At the scale of individual farms, irrigators have very limited ability to 'bank' water in order to obtain reduced future pumping lifts. Higher water levels resulting from reduced groundwater withdrawals result in a net change in gradients that casues much of the saved water to flow out from under the management area. In the absence of management policies that extend over regions much greater than the scale of individual farms, there may be very little inccentive for an individual irrigator to reduce groudwater withdrawals. At the scales typical of regional management, reductions in pumpage will result primarily in reductions in water level declines within the management area. (Wood-PTT)
W88-00023

STOCHASTIC IDENTIFICATION OF TRANSMISSIVITY AND EFFECTIVE RECHARGE IN STEADY GROUNDWATER FLOW: 2. CASE STUDY,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
For primary bibliographic entry see Field 2F.
W88-00031

SEAWATER INTRUSION CONTROL WITH WASTEWATER,
Ventura Regional County Sanitation District, CA.
J. J. Wedding, and H. V. Kondru.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 485-500, 9 fig, 8 ref.

Descriptors: *Water reuse, *Groundwater, *Groundwater management, *Groundwater pollution, Aquifers, Wastewater, Wastewater management, Wastewater renovation.

A primary benefit of using reclaimed wastewater to control seawater intrusion would be increased use of groundwater storage. The beneficial effects of the increased use of groundwater storage include: use and storage of surplus water, possible improvement of groundwater quality by recharging with good quality surface water, and postponement of the need to construct additional surface storage facilities. Groundwater storage has several advantages when compared with surface storage reservoirs. There is an elimination of the evaporation that is a significant fact in surface storage reservoirs. Biological quality problems are minimized because of the absence of light required for aquatic growth. In addition, groundwater storage is less subject to damage through sabotage and spills than is surface storage. The use of reclaimed water as a hydraulic barrier to stabilize and repulse the seawater intrusion front is a system for conserving water resources. Disposal of treated effluent to the ocean is a water wasting method in areas where the water supply is limited. (See also W88-00164) (Author's abstract)
W88-00185

ARTIFICIAL RECHARGE OF RECLAIMED WASTEWATER INTO AN UNCONSOLIDATED COASTAL AQUIFER,
National Inst. for Water Research, Bellville (South Africa). Cape Regional Lab.
G. Tredoux, and W. Tworeck.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 26-31, 1 tab, 2 ref.

Descriptors: *Groundwater management, *Recharge, *Wastewater renovation, Groundwater recharge, Wastewater treatment, South Africa, Water reuse, Artificial recharge, Infiltration, Induced infiltration, Coastal aquifers, Geohydrology, Aquifer management, Fate of pollutants.

An experimental wastewater recharge facility was constructed at Cape Flats, South Africa. It was composed of five open basins on the perimeter of a 100 m radius circle, two abstraction wells near the center of the circle, and thirty observation wells. Oxidation pond effluent, prechlorinated and coagulated to prevent flotation of algae, was recharged at the rate of 3.5 to 15 m/day. Recharge proceeded at acceptable rates as long as effluent turbidity was maintained at 2 NTU or less. Turbidity values of 3 to 5 NTU produced declining recharge rates and clogging of the sand surface within 14 days. Mechanical removal of the clogged infiltration surface restored the recharge capacity. Retention time of recharged water in the aquifer varied (using chloride as a tracer) from 60 to 200 days. The abstraction well produced water of good bacteriological quality. No E. coli were isolated from this water at any stage of the experiments. The maximum distance that E. coli were transmitted was 27 m from the recharge point. Recharged water present in the abstracted water reached a maximum of 67%. (See also W88-00373) (Cassar-PTT)
W88-00391

BOREHOLE DEVELOPMENT AND REHABILITATION,
J. Kirchner.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 50-59.

Descriptors: *Groundwater management, *Well yield, Hydrochloric acid, Sodium hexametaphosphate, South Africa, Boreholes, Water supply.

Inhibited hydrochloric acid (Hibitol) and sodium hexametaphosphate (Calgon) assisted by surging improved the yields of aquifers in borehole tests conducted at several sites in southwestern Africa. Production in a borehole flushed with acid and Calgon increased from 3 to 14.5 cu m/hr. (See also W88-00373) (Cassar-PTT)
W88-00393

OPTIMIZING THE CONJUNCTIVE USE OF SURFACE AND GROUNDWATER,
B. J. Middleton, and C. Langhout.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 90-98, 2 fig.

Descriptors: *Groundwater management, *Evaluation, *Conjunctive use, *Water supply, Optimization, Surface water, Reservoirs, Cost analysis, Mines, Recharge, Schweizer Reneke, South Africa, Water storage, Planning.

Two examples of optimizing conjunctive water use are described. In the first, a water supply for a proposed mine was considered. A graph showed that the most economical scheme would use a reservoir with a storage capacity of 60% of the mean annual runoff. This would supply about 80% of the total demand while 20% would be derived from groundwater. In the second example the water supply of the town of Schweizer Reneke needed to be increased. The optimum solution was to raise the dam wall to increase the storage capacity because the incremental cost of groundwater development rose more sharply than that of reservoir water. (See also W88-00373) (Cassar-PTT)
W88-00397

CASE HISTORY OF OPEN PIT MINE DEWATERING AT LETLHAKANE MINE, BOTSWANA,
R. J. Connelly.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 165-174, 3 fig.

Descriptors: *Groundwater management, *Wells, *Mining industry, South Africa, Diamond mines, Geohydrology, Aquifer characteristics, Dewatering, Letlhakane Mine, Botswana, Dewatering.

A dewatering system was designed for the Letlhakane Mine, Botswana. This mine consists of two small kimberlite pipes. One pipe, 30 m deep, is actively mined. Water is encountere at 20 m below the surface. A deep well system of seven wells was specified to intercept water from all the aquifers. Wells were placed outside the perimeter of the 10 to 15 year mine plan. Gravel packing was used in the calcrete horizon to prevent the soil from coming through the wide slots in the casing. A slotted PVC pipe was placed in the gravel pack, through which acid can be introduced to dissolve calcium carbonate precipitate. (See also W88-00373) (Cassar-PTT)
W88-00401

RAFT RIVER MONITOR WELL POTENTIOMETRIC HEAD RESPONSES AND WATER QUALITY AS RELATED TO THE CONCEPTUAL GROUND-WATER FLOW SYSTEM,
EG and G Idaho, Inc., Idaho Falls.
D. W. Allman, J. A. Tullis, M. R. Dolenc, T. L. Thurow, and P. A. Skiba.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-002087. Price codes: A06 in paper copy, A01 in microfiche. EGG-2215, Vol. 2, September 1982. 60 p, 32 fig, 3 tab, 34 ref. Contract No. DE-AC07-761D01570.

Descriptors: *Groundwater, *Groundwater pollution, *Groundwater movement, Geohydrology, Groundwater irrigation, Groundwater reservoirs, Aquifers, Well data, Test wells, Idaho.

A groundwater monitoring program is discussed, which was established to assess the concerns that high pressure injection of spent thermal fluid (from power generation) into an intermediate-depth aquifer could adversely affect nearby irrigation wells in a shallow aquifer. Results indicate that head pressure at the various irrigation wells, and at test wells drilled into the same aquifer as the irrigation wells, fluctuated as a result of the high pressure injection. Various patterns of water quality degradation, due to the high pressure injection, were also observed. (Halterman-PTT)
W88-00473

ESTIMATION OF VERTICAL HYDRAULIC CONDUCTIVITY OF THE CLAY LAYER BETWEEN THE EUTAW AND GORDO AQUIFERS IN THE VICINITY OF FAUNSDALE, MARENGO COUNTY, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-00558

STATISTICAL CHARACTERIZATION AND NUMERICAL SIMULATION OF A FRACTURE SYSTEM -- APPLICATION TO GROUNDWATER FLOW IN THE STRIPA GRANITE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W88-00560

METHOD AND APPARATUS FOR INSTALLING GROUNDWATER BARRIER,
Stevin Construction Inc., Dover, DE.
P. G. van Klinken.
U.S. Patent No. 4,484,835; November 27, 1984. 11 p, 19 fig. Official Gazette of the United States Patent Office, Vol 1048, No 4, p 1584-1585, November 27, 1984.

Descriptors: *Patents, *Groundwater barriers, *Soil sealants, *Piles, *Screens, Groundwater movement, Water control.

Multiple flexible water restraining non-self-supporting sheets are introduced into the soil for the development of a groundwater barrier. A first sheet is introduced downward through the soil by attaching its lower edge to a liquid ejecting lance having substantially the same width as the sheet. The lance and sheet move together downward through the soil while a liquid is simultaneously ejected from the lance in front of the path of movement. Once the sheet is in place, the lance is disconnected from it and retracted from the soil. A second sheet is then introduced by positioning it so that it overlaps the first sheet, allowing sealing in the area of overlap. The lance is removed utilizing vibrations. Additionally, hardening materials are injected along the sheet joints. Holes are drilled on either side of the sheet widths to allow the escape of water used by the injection lance and the injection of hardening material in the holes where the edges of the two succeeding sheets adjoin. (Hancuff-AEPCO)
W88-00573

METHOD FOR CONSTRUCTING A SCREEN THAT OBSTRUCTS THE FLOW OF SUBSOIL WATER,
Stevin Construction Inc., Dover, DE.
P. G. van Klinken.
U.S. Patent No. 4,607,981; August 26, 1986. 8 p, 9 fig. Official Gazette of the United States Patent Office, Vol 1069, No 4, p 1618, August 26, 1986.

Descriptors: *Patents, *Screens, *Water pollution control, *Groundwater barriers, *Groundwater control, *Obstruction to flow, *Subsoil drainage, *Flow discharge, *Retaining walls, Flow profiles, Subsoil, Soil sealants, Films, Flow obstruction.

An in-soil water retention screen obstructs the flow of subsoil water by using retaining wall elements. The elements engage and are shaped like wide supple films or sheets. At least two webs of supple film material are positioned with a longitudinal side edge of the first web adjacent to a longitudinal side edge of the second web, and a first profile member positioned along the longitudinal side edge of the first web. This profile member slides within and cooperates with the second profile member. The cooperating profiles contain cross sections which are interlocked to resist separation in the direction perpendicular to the profiles and in the plane of the webs. The profiles are small enough to allow insertion of the profile and web together using a flushing lance. (Cremmins-AEPCO)
W88-00583

WATERPROOFING SOIL,
Clem Environmental Corp., Chicago, IL.
For primary bibliographic entry see Field 5G.
W88-00614

UNINHIBITED BENTONITE COMPOSITION,
American Colloid Co., Skokie, IL.
T. D. Harriett.
U.S. Patent No. 4,534,925; August 13, 1985. 7 p, 6 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1057, No 2, p 791, August 13, 1985.

Descriptors: *Patents, *Bentonite, *Barriers, *Expansive soils, *Seepage control, Elastomers, Polymers, Waterproofing, Hydration.

A non-hydrated, bentonite composition for constructing water barriers comprises a mixture of bentonite clay with polypropene, polybutene, or mixtures thereof. In a second composition, an elastomer such as partially cross-linked butyl rubber is added to the composition. The elastomer has sufficient resiliency to stretch upon hydration of the bentonite to add structural integrity to the composition. With and without the elastomer, the compositions, including polypropene or polybutene in an amount of at least 10% by weight, are capable of swelling more than bentonite alone. After mixtures of the bentonite with the polypropene, polybutene or mixtures, other additives such as tackifiers, viscosity modifiers, thickeners, and extenders may be added. The polypropene and/or polybutene add sufficient tackiness to the bentonite composition and completely wet-out the clay upon initial mixing to prevent bentonite inhibiting additives from substantially inhibiting the swelling properties of the bentonite. The polypropene and/or polybutene components of the composition do not dry out over substantial periods of time. (Cremmins-AEPCO)
W88-00620

STRATEGY FOR THE PROTECTION OF UNDERGROUND WATER IN ILLINOIS.
Illinois State Environmental Protection Agency, Springfield. Water Plan Task Force.
For primary bibliographic entry see Field 5G.
W88-00666

GROUND WATER MANAGEMENT UNDER THE APPROPRIATION DOCTRINE, PART I,
Idaho Univ., Moscow. Dept. of Geology.
For primary bibliographic entry see Field 6E.
W88-00726

SPECIAL GROUND WATER STUDY: BASIN-WIDE REPORT AND EXECUTIVE SUMMARY.
Delaware River Basin Commission, West Trenton, NJ.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-153262. Price codes: A09 in paper copy, A01 in microfiche. December 1982. 148 p, 27 exhibits.

Descriptors: *Groundwater management, *Water law, *Delaware River, Monitoring, Regulations, Legal aspects, Water policy, Hydrology, Regional planning, Aquifers, Water quality, Political aspects.

Data on groundwater systems were collected in three areas of the Delaware River Basin. These areas were the coastal plain (Delaware and southern New Jersey), the middle basin, and the upper basin. Groundwater management in the Delaware River basin is involved with a complicated web of statutes, regulations, jurisdictions, and authorities. On the one hand, the local involvement ensures that all geographic scales are addressed. On the other hand, resolution of broader, regional issues is difficult. Existing and projected groundwater problems and issues are described under the following categories: (1) groundwater recharge, baseflow, and impacts of groundwater development, (2) groundwater quality, (3) water withdrawal permits, and (4) data collection and analysis deficiencies. A basinwide management program is recommended. It recognizes the interrelation of the groundwater and surface water resources. The program provides technical criteria for more uniform regulatory functions and signatory parties to protect the available quantity of groundwater and to regulate water withdrawals and use in a responsible and equitable manner. It also presents a plan for coordinated data collection and monitoring. (Cassar-PTT)
W88-00916

SPECIAL GROUNDWATER STUDY OF THE MIDDLE DELAWARE RIVER BASIN, STUDY AREA II, VOLUME III, (CHAPTERS 12-14),
Wright (R.E.) Associates, Middletown, PA.
R. E. Wright.
(1983). 88 p, 4 fig, 3 ref, append. Prepared for the Delaware River Basin Commission.

Descriptors: *River basins, *Interstate rivers, *Water management, *Groundwater management, *Policy making, *Administrative aspects, *Legal aspects, Well regulation, Groundwater depletion, Competing uses, Water use, Operating policies, Decision making.

This volume contains the chapters on existing groundwater management, a recommended groundwater management program, and the summary conclusions and recommendations related to all the topics covered in the four volumes of the Special Groundwater Study of the Middle Delaware River Basin. Currently, about 1,000 mg/d of groundwater is pumped from wells within the Delaware River Basin. This amount of groundwater has not yet been subject to the management scrutiny its value deserves, primarily because the level of sophistication employed in groundwater resource management seriously lags behind surface water management. There are conflicts due to variations in laws and policies toward the use of groundwater within the Basin. Some possible control or management mechanisms include: setting maximum drawdown limits, restricting well density within a groundwater basin, monitoring and restricting depletive use, restricting duration of pumpage, and selecting management zones based on physical and cultural parameters. Allocation of groundwater should not rely solely on already established groundwater pumping rates based upon annual recharge data. Rather, groundwater allocation policy needs to incorporate supply reliability, depletion, water quality, interference, and streamflow maintenance considerations. A basin-wide groundwater management program should be adopted which is founded upon an evaluation of each significant withdrawal to assess its impact upon the hydrogeologic system. (See W88-00921 thru W88-00923) (Hawkins-Omniplan)
W88-00924

4C. Effects On Water Of Man's Non-Water Activities

OVERLAND FLOW AND SEDIMENT DELIVERY FIVE YEARS AFTER TIMBER HARVEST IN A MIXED CONIFER FOREST, ARIZONA, U.S.A.,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
B. H. Heede.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 205-216, June 15, 1987. 2 fig, 2 tab, 16 ref.

Descriptors: *Overland flow, *Sediment transport, *Logging effects, *Soil erosion, *Forest management, Coniferous forests, Logging, Conifers, Trees, Arizona, Runoff rates, Runoff, Soil erosion, Seasonal variation.

Timber was harvested for the first time in a mixed conifer forest of the Arizona White Mountains in 1978-1979. Trees were harvested by patch cuts and group selection. Logs were yarded by crawler tractors. After harvest, 19 small subdrainages were equipped with runoff and sediment collectors. The forest floors in the subdrainages were classed as undisturbed, moderately disturbed, or severely disturbed. Severe disturbance, caused by logging and monitoring activities, was associated with a pre-existing erosion pavement that had developed for unknown reasons. Although overland flow and sediment delivery differed significantly between the severely disturbed and undisturbed groups during the 5 year postharvest period, all quantities were practically insignificant. The group severely disturbed by logging had an average of only 0.006 mm/year annual soil loss. Overland flows ranged between 0.7 and 15.4 mm/year and sediment between 5.67 and 268.78 kg/hectare/year. Summer yield of overland flow and sediment delivery were significantly higher than those in winter. Precipitation amounts were about equal for both seasons, but summer precipitation is of monsoon origin. Flow and sediment yields were not significantly different between moderately disturbed and undisturbed forest floor. Recovery from disturbance could not be detected. (Author's abstract)

W88-00004

DROUGHT IN AFRICA,
For primary bibliographic entry see Field 2B.
W88-00101

LOSS OF COASTAL GRAZING MARSHES IN SOUTH AND EAST ENGLAND, WITH SPECIAL REFERENCE TO EAST ESSEX, ENGLAND,
Royal Society for the Protection of Birds, Sandy (England).
G. Williams, and M. Hall.
Biological Conservation, Vol. 39, No. 4, p 243-253, April 1987. 3 fig, 1 tab, 18 ref.

Descriptors: *Birds, *Coastal wetlands, *Wetlands, *Drainage effects, *England, *Coastal marshes, *Environmental effects, Water birds, Conservation, Wildlife conservation, Essex, Marshes, Ecology, Ecosystems, Agriculture.

Freshwater, coastal grazing marshes provide an attractive habitat for breeding and wintering birds. In recent years, such areas have frequently been subjected to draining improvements and conversion to arable land. In east Essex, a land-use study of 16,000 ha of the coastal zone between Clacton-on-Sea in the north to Burnham-on-Crouch in the south showed that between 1938 and 1981, the area of coastal grassland decreased from 11,749 ha to 2083 ha- a reduction of 9,666 ha (82%). Most of this loss (92%) has occured as a result of conversion to arable land. The rates of conversion to arable land were particularly high between 1938 and 1947 as a result of wartime increases in agricultural production and from 1970-1981, coinciding with Britain's entry into the European Community and favorable cereal prices under the Common Agricultural Policy. The rate of loss of east Essex coastal grazing marsh is comparable to that of Romney Marshes, Kent; however it is much larger than for the North Kent Marshes (49% loss from 1935 to 1982); and the Broadland Marshes of Norfolk and Suffolk (37% loss from 1930 to 1984). (Author's abstract)
W88-00112

PEATLAND HYDROLOGIC IMPACT MODEL: DEVELOPMENT AND TESTING,
Arizona Univ., Tucson. School of Renewable Natural Resources.
D. P. Guertin, P. K. Barten, and K. N. Brooks.
Nordic Hydrology NOHYBB, Vol. 18, No. 2, p 79-100, 1987. 8 fig, 2 tab, 42 ref.

Descriptors: *Wetlands, *Environmental effects, *Drainage effects, *Peat mining effects, *Logging effects, *Streamflow response, *Model studies, *Streamflow forecasting, *Streamflow, Data interpretation, Peatland Hydrologic Impact Model, Simulation, Minnesota, Great Lakes, Mathematical equations, Watersheds.

Questions concerning the effects of drainage, peat mining, and timber harvesting on streamflow response in the northern Lake States of the U.S.A. led to the development of the Peatland Hydrologic Impact Model (PHIM). PHIM is a generalized, deterministic, continuous simulation model, that is physically-based to the extent possible. Three independent landtype submodels represent watershed conditions common in the region. The appropriate land-type submodel(s), either natural peatland (NWATBAL), mined peatland (MWATBAL), or mineral soil upland (UWATBAL) are configured by the model user to represent the watershed. The submodels were applied to test the model on the streamflow response from three different peatland watersheds. Stormflow events were simulated for a 3,758 hectare (ha) natural peatland and a 155 ha mined peatland. Annual water yield simulations for a 9.72 ha upland-peatland watershed produced a mean ratio of predicted/observed streamflow of 1.01 plus or minus 0.08 for six test years. The model is generalized so that it should be adaptable to similar physiographic regions with minor modifications. (Author's abstract)
W88-00130

EFFECTS OF GRAZING BY FERAL HORSES, CLIPPING, TRAMPLING, AND BURNING ON A GEORGIA SALT MARSH,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2L.
W88-00139

ASSESSING THE EFFECTS OF COAL MINING AND RELATED ENERGY DEVELOPMENT ON AQUATIC ENVIRONMENTAL QUALITY IN THE UPPER COLORADO BASIN,
Utah Water Research Lab., Logan.
K. Gernerd, J. J. Messer, F. J. Post, and V. A. Lamarra.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 383-397, 5 fig, 10 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Coal mining, *Mine wastes, *Environmental effects, *Water quality, *Aquifers, Fate of pollutants, Colorado River, Leachates, Aquatic life, Metals, Sulfates, Groundwater pollution, Gasification, Coal gasification, Powerplants, Electric power production, Energy.

Impacts of coal development in the upper Colorado River basin are described. During exploration test drilling can liberate saline water into other aquifers or surface water. Extraction of coal can produce alkaline or acid mine drainage loaded with silt, depending on the overburden. Aquifers can be disrupted causing lowered well levels or contamination of water supplies. Runoff from coal piles may be acidic and liberate sulfate and heavy metals and particulate matter into groundwater and surface water. Reclamation activities can produce land with high erosion potential and water with high sulfate, dissolved metals, and cation concentrations. The aquatic ecosystem would be severely affected by floc from lime neutralization. Power production using coal generates several pollutants: heat, heavy metals, biocides. Cooling ponds can increase discharge of groundwater to wetlands. Coal gasification and liquefaction produce many contaminants: hydrocarbons, tars, fly ash, sulfur compounds, ammonia, cyanide, phenols, heavy metals, which can pollute groundwater and surface water. (See also W86-02484) (Cassar-PTT)
W88-00356

POTENTIAL IMPACTS OF ENERGY DEVELOPMENT UPON WATER QUALITY OF LAKE POWELL AND THE UPPER COLORADO RIVER,
Colorado Univ., Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 5B.
W88-00357

RECORD OF DECISION FOR THE RESOURCE MANAGEMENT PLAN/FINAL ENVIRONMENTAL IMPACT STATEMENT.
Bureau of Land Management, Casper, WY.
For primary bibliographic entry see Field 6G.
W88-00474

ARRANGEMENT FOR DAMMING WATER AND ALSO FOR DRAINING AWAY THE VOLUME OF WATER ABOVE A CERTAIN LEVEL IN VEGETATION-BEARING STRATUM,
For primary bibliographic entry see Field 8A.
W88-00500

MISSISSIPPI RIVER NAVIGATION SYSTEM: ENVIRONMENTAL EVALUATIONS OF PROPOSED MOORING FACILITIES,
Versar, Inc., Springfield, VA.
For primary bibliographic entry see Field 6G.
W88-00648

IMPACT OF PROPOSED RUNWAY EXTENSION AT LITTLE ROCK MUNICIPAL AIRPORT ON WATER-SURFACE ELEVATIONS AND NAVIGATION CONDITIONS IN ARKANSAS RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. P. Stewart, L. L. Daggett, and R. F. Athow.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-155588. Price codes: A04 in paper copy, A01 in microfiche. Miscellaneous Paper HL-85-3, May 1985. Final Report. 65 p, 42 fig, 5 append.

Descriptors: *Airports, *Arkansas River, *Navigation, Hydrodynamics, Model studies, Water surface elevation, Sediment transport.

In response to an application to place fill material and bank stabilization stone in connection with the construction of a runway, a study was conducted to assess the impact of the fill on water-surface elevations and navigation conditions. Predictions on impacts were made with a two-dimensional numerical hydrodynamic model that was coupled with a two-dimensional numerical sediment transport model. Results of the study indicate that the runway will have a noticeable effect on the water surface profile in the study area, but will not violate the 0.5-foot maximum swellhead criterion. Water velocities in the study area are predicted to increase 10%. There is no indication that the construction will affect navigation in the area. (Halterman-PTT)
W88-00818

POLLUTION FROM ALASKAN OIL AND GAS OPERATIONS: CITATIONS FROM THE OCEANIC ABSTRACTS DATA BASE (1974-NOV 82).
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W88-00911

ACID PRECIPITATION: EFFECTS ON THE AQUATIC ECOSYSTEM; CITATIONS FROM THE U.S. DEPARTMENT OF ENERGY (EDB) DATA BASE (1977-SEPT 83).
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W88-00912

4D. Watershed Protection

BEACH EROSION PREVENTION JETTY CONFIGURATION,
H. H. Szonnell.
U.S. Patent No. 4,498,806; February 12, 1985. 6 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1051, No 2, p 622, February 12, 1985.

Descriptors: *Patents, *Beach erosion, *Erosion control, *Jetties, *Wave action, Venturi effect, Channel erosion, Channel flow, Tidal waves, Tidal currents, Inlets, Wave direction, Shore protection.

Beach erosion from the venturi effect is prevented using curved jetties at the entrances to an inlet. The venturi effect that pulls sandy waters from the shorelines is created by swift currents running in or out of inlets. The curved jetties redirect coastal currents in wash channels away from the inlet. Waves push eroded sand back toward the shore. A safe sloped beach is then created. (Cremmins-AEPCO)
W88-00587

EROSION CONTROL BLOCKS,
Terrafix Erosion Control Products, Inc., Islington (Ontario).
R. E. Crowe.
U.S. Patent No. 4,436,447; March 13, 1984. 5 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1040, No 2, p 681, March 13, 1984.

Descriptors: *Patents, *Bank erosion, *Wind erosion, *Wave action, *Erosion control, *Concrete construction, Concretes, Soil stability, Watercourses.

Concrete blocks are used to control erosion of banks of bodies of water based on the inter-locking ability and weight of the blocks. The concrete erosion control blocks contain a pair of longitudinally spaced spigots on one side surface and at least one longitudinally elongated slot in an opposite side surface. The spigots and slot or slots are located to interengage respectively with slots and spigots of blocks laid in adjacent parallel courses. The interaction of the spigots and the slots allows better accommodation of the stresses applied to a bed of blocks by wave action and better consolidation of the bed under the influence of such action. By comparison, conventional spigot and socket construction provides a degree of flexibility of the bed, but little scope for dimensional adjustment in the place of the bed. Tongue and groove arrangements are flexible in one dimension only, while flexural stresses tend to lock the blocks together and prevent longitudinal movement between courses. The slots in the concrete block may have a limited longitudinal extent and spacing corresponding to that of the spigots, or a single continuous slot may extend from end to end of the block. (Cremmins-AEPCO)
W88-00600

REVETMENT FOR PROTECTING THE INCLINED SURFACES OF BEACHES, SHORES, RIVERS OR CHANNELS, AND OF STRUCTURES SUCH AS MOLES, DIKES, OR CHANNEL WALLS, LOCATED IN THESE PLACES, AGAINST EROSION BY WAVES AND FLOWING WATER,
For primary bibliographic entry see Field 8D.
W88-00605

EROSION CONTROL DEVICE,
R. C. Berger, and J. W. Smack.
U.S. Patent No. 4,483,640; November 20, 1984. 4 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1048, No 3, p 1161-1162, November 20, 1984.

Descriptors: *Patents, *Erosion control, *Flow discharge, *Runoff, *Water quality control, Silt, Mud, Sediments.

A portable erosion control device filters runoff water from exposed soil to prevent silt and mud from washing into urban streams. The device comprises two vertical side members arranged orthogonally with respect to two vertical end members. The side and end members form a box-like framework. The side members include openings large enough to permit the flow of water. The side members are substantially impervious to the flow of water. Partitions extend between the end walls of the box-like framework and are spaced with respect to each other to form compartments within the framework. Gripping members are positioned on the end members to facilitate the lifting and positioning of the framework relative to the ground level. Filtering material is positioned in the compartments. The open bottom permits filtering material to be dispensed from the framework when it is elevated above ground level. (Cremmins-AEPCO)
W88-00606

BEACH EROSION PREVENTION JETTY CONFIGURATION,
H. H. Szonnell.
U.S. Patent No. 4,498,806; February 12, 1985. 6 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1051, No 2, p 622, February 12, 1985.

Descriptors: *Patents, *Beach protection, *Shore protection, *Erosion control, *Beach erosion, *Jetties, *Wave action, *Inlets, Safety, Venturi effect, Water currents, Water control, Wastershed management, Swimming.

The venturi effect is negated and beach erosion is prevented using a curved jetty to create a naturally sloped beach. The curved or angled end of the jetty hinders the coastwise current in a swash channel from moving toward an inlet. Subsequently, waves push sand toward the shore to build islands similar to unbroken chains of barrier reefs. The jetty configuration adds to safety of swimming near the mouths of rivers and other bodies of water. (Cremmins-AEPCO)
W88-00608

LIGHTWEIGHT SEMI-FLEXIBLE DIKE,
Shell Offshore, Inc., Houston, TX.
S. Nandlal.
U.S. Patent No. 4,521,131; June 4, 1985. 7 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1055, No 1, p 221, June 4, 1985.

Descriptors: *Patents, *Erosion control, *Slope protection, *Shore protection, *Energy dissipation, *Absorption loss, *Bank protection, Wave action, Watershed management, Energy loss, Hydrodynamics, Bank erosion, Water control.

Erosion is controlled along a river bank or other bodies of water by constructing or installing a lightweight, semi-permeable core, semi-flexible structure in the form of a dike or breakwater. A trench is excavated in the land forming a bank. The bottom of the trench and at least the trench wall toward the water are covered with a woven synthetic permeable, flexible fabric to form a trench cover so as to separate dike building material from the trench subsoil and to inhibit the migration of fines into the underlying soils. Dike material is mixed from shells, sand and cement. The mixture minimizes the seepage of water through the dike core resulting in minimal pore pressure build-up in the underlying sands. The mixed material is then spread in shallow layers in the trench where it is compacted between layers. After the dike has been built to the designated height, its crest and at least the water side slope are covered with a second synthetic fabric to form a dike cover that is permeable to water but impermeable to substantially all of the fine solid material in the shell-sand-cement mixture. Subsequently, the dike covering is anchored on the top of the dike and at least the water side slope of the dike by positioning the layer of rock filled gabions over the fabric. The dike is compliant to the degree that a portion of the structure may sag into the subsoil without any large cracks forming which could be further eroded by a current of river water or by waves. (Cremmins-AEPCO)
W88-00609

FLUID WAVE ENERGY DISSIPATING AND ABSORBING STRUCTURE,
M. T. Conover.
U.S. Patent No. 4,362,432; December 1, 1982. 6 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1025, No 1, p 185, December 7, 1982.

Descriptors: *Patents, *Slope protection, *Sea walls, *Bank protection, *Shore protection, *Erosion control, *Energy dissipation, *Absorption loss, Wave action, Watershed management, Energy loss, Hydrodynamics, Bank erosion, Water control.

Fluid wave energy is dissipated and absorbed using a structure with one surface exposed to wave action and comprising an array of alternating three-sided pyramidal protuberances and triangular flat spaces. The fluid is redirected over the points and edges of surface protrusions by exposing a substantially increased surface area to the wave in comparison to flat seawalls and by providing an opportunity for wave cancellation. Waves striking the structure are less likely to splash over it, thereby eliminating erosion behind the structure as well as reducing the amount of erosion and undermining in front of it. (Cremmins-AEPCO)
W88-00610

METHODS OF COMPUTING SEDIMENTATION IN LAKES AND RESERVOIRS.
For primary bibliographic entry see Field 2J.
W88-00694

METHODS OF PRESERVING RESERVOIR CAPACITY,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
For primary bibliographic entry see Field 2J.
W88-00698

STUDY OF RUNOFF AND EROSION PROCESSES USING LARGE AND SMALL RAINFALL SIMULATORS,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-00714

ECONOMIC DIFFERENCES BETWEEN CUMULATIVE AND EPISODIC REDUCTION OF SEDIMENT FROM CROPLAND,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2J.
W88-00729

LONG TERM SEDIMENT DEPOSITION IN THE RIPARIAN ZONE OF AN AGRICULTURAL WATERSHED,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 2J.
W88-00742

ALASKAN OFFSHORE DRILLING BASE,
Shell Oil Co., Houston, TX.
For primary bibliographic entry see Field 8A.
W88-00758

STABILIZATION OF PARTICULATE MATERIAL,
For primary bibliographic entry see Field 8A.
W88-00765

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DESIGN OF A GROUND-WATER SAMPLER FOR COLLECTING VOLATILE ORGANICS AND DISSOLVED GASES IN SMALL-DIAMETER WELLS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 7B.
W88-00018

GC/MS IDENTIFICATION OF ORGANOSULPHUR COMPOUNDS IN ENVIRONMENTAL SAMPLES,
Alberta Environmental Centre, Vegreville.
J. V. Headley.
Biomedical and Environmental Mass Spectrometry, Vol. 14, No. 6, p 275-280, June 1987. 2 tab, 29 ref.

Descriptors: *Pollutant identification, *Organosulfur compounds, *Sulfur compounds, *Gas chromatography, *Mass spectrometry, Sulfur, Industrial wastes, Sediments, Bioaccumulation, Trace levels, Chlorination, Odors, Fish, Alberta.

Twenty-one organosulfur compounds were detected in a survey of water, industrial effluent, sediment and fish samples, using automated gas chromatography/mass spectrometry developed for the identification of forty target semi-volatile and volatile organosulfur compounds. The 2,000 samples tested came from environmental sources throughout Alberta and were collected from October 1982 through September 1983. The compound classes detected in the environmental samples are three allotropes of sulfur, three thioethers, five sulfones, six thiophenes, one thiol, two sulfonamides and one thiazole. The compounds were detected in the approximate concentration range 0.1 to 2000 parts per billion (ppb). Alpha, alpha-dichlorodimethyl sulfone was detected in environmental samples

subjected to biodegradation and chemical treatment. (Airone-PTT)
W88-00059

WHAT DOES THE PRESENCE OF FECAL COLIFORMS INDICATE IN THE WATERS OF PUERTO RICO, A REVIEW,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
T. C. Hazen, J. Santiago-Mercado, G. A. Toranzos, and M. Bermudez.
Boletin de la Asociacion Medica de Puerto Rico, Vol. 79, No. 5, p 189-193, May 1987. 2 fig, 3 tab, 32 ref. NIH Public Health Service grants RR-2657 and RR-8102.

Descriptors: *Bioindicators, *Coliforms, *Escherichia coli, *Tropical regions, *Drinking water, Bacteria, Feces, Streams, Epiphytes, Surface water, Bioindicators, Puerto Rico.

High numbers of total and fecal coliform bacteria have been detected in pristine streams and in water samples collected from epiphytic vegetation 30 feet above ground in the rain forest of Puerto Rico. Identification of fecal coliform isolates demonstrated the presence of Escherichia coli in these samples. Nucleic acid (DNA) analysis indicated that the guanosine + cytosine content of the environmental isolates was identical to that of clinical isolates of E. coli. Diffusion chamber studies with E. coli at several freshwater sites revealed that this bacterium can survive indefinitely in most freshwaters in Puerto Rico. An evaluation of methods for enumeration of fecal coliforms showed that currently used media have poor reliability as a result of large numbers of false positive and false negative results when applied to Puerto Rican environmental water samples. Based on these findings total and fecal coliform bacteria may not be reliable indicators of recent biological contamination of waters in Puerto Rico or other tropical areas. (Author's abstract)
W88-00060

THM FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
A. Bruchet, C. Anselme, O. Marsigny, and J. Mallevialle.
Aqua AQUAAA No. 2, p 102-109, 1987. 14 fig, 4 tab, 17 ref.

Descriptors: *Trihalomethanes, *Water treatment, *Chlorination, *Chlorinated hydrocarbons, *Mass spectrometry, *Gas chromatography, *Water pollution sources, Chloroform, Water quality, Humic acids, Fulvic acids, Tannins, Organic compounds, Aromatic compounds, Pyrolysis.

The work of many authors indicates that the chlorination of water leads to the formation of trihalomethanes. This fact has been quickly attributed to the humic and fulvic acids present in water. The great differences observed from one water to another, for a same chloride to organic carbon ratio, are not explained. Pyrolysis/gas chromatography/mass spectrometry was applied to, first, various standard substances (lignins, tannins, humic substances) and, second, natural ground and surface waters, and their trihalomethane formation potential (THMFP) was characterized as a function of macromolecule content. The order of decreasing THMFP found in the standards was polyphenolics, proteins, carbohydrates. The approximate proportion of the different types of biological macromolecules shows a good relationship with THMFP of the individual waters investigated. (Airone-PTT)
W88-00065

EVOLUTION OF ORGANICS IN A POTABLE WATER TREATMENT SYSTEM,
Compagnie Generale des Eaux, Paris (France). Groupe Traitement de l'Eau.
For primary bibliographic entry see Field 5F.
W88-00066

TOXIC SITUATION TO LEPIDIUM SATIVUM IN THE WUPPER RIVER - A SUPPLEMENTAL METHOD OF WATER QUALITY SURVEILLANCE (DIE TOXIKOLOGISCHE SITUATION DER WUPPER GEGENUEBER DER GARTENKRESSE (LEPIDIUM SATIVUM) - EINE ERGAENZENDE METHODE DER GEWAESSERGUETEUEBERWACHUNG),
Stadtverwaltung Amt, Duesseldorf (Germany, F.R.). Chemisch-Biologische Lab.
T. Bendt.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 20, No. 2, p 91-93, June 1987. 2 fig, 2 tab, 7 ref.

Descriptors: *Water pollution effects, *Toxicity, *Aquatic plants, *Heavy metals, *Testing procedures, Water pollution sources, Chemical analysis, Roots, Rivers, Toxicity, Wupper River.

The cress seed test demonstrated that the Wupper River below Marienhagen has an inhibitory effect on the root growth of Lepidium sativum. Simulation tests showed that an increased heavy metal burden is the reason for this inhibition, which extends to Wuppertal-Rutenbeck. In order to confirm the results the ecological valence of Lepidium sativum has been determined experimentally. Chemical analyses of a sample are recommended before its testing in order to avoid false results. (Airone-PTT)
W88-00071

LACK OF BIOACCUMULATION OF METALS BY ELLIPTIO COMPLANATA (BIVALVIA) DURING ACIDIC SNOWMELT IN THREE SOUTH-CENTRAL ONTARIO STREAMS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. R. Servos, D. F. Malley, G. L. Mackie, and B. D. LaZerte.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 762-768, May 1987. 3 fig, 17 ref. Canadian Dept of Fisheries and Oceans, the Ontario Ministry of the Environment, and the National Research Council of Canada Contract 0754-31048-0-3931.

Descriptors: *Bioassay, *Metals, *Acidic snowmelt, *Ontario, *Path of pollutants, *Snowmelt, *Streams, *Clams, *Water pollution, *Aluminum, *Zinc, *Cadmium, Hydrogen ion concentrations, Tissue analysis, Emission spectrometry, Flame atomic absorption spectrometry, Temperature effects.

The feasibility of using biomonitoring to detect short-term changes in concentration or bioavailability of metals (Al, Zn, Cd) during spring snowmelt was determined. Unionid clams were held in three south-central Ontario streams during the snowmelt of 1982. The concentration of metals in soft tissues (gill, body, foot) was compared separately to the stream water chemistry during snowmelt. Samples were analyzed for total Al (D.C. emission spectrometry) Zn, and Cd (flame atomic absorption spectrometry). There was no increase in the concentration of metals in either gill or body tissues in any of the streams. Although both Al and Cd concentrations in the foot tissue increased with time, the concentrations of Al and Cd were not different between streams. E. complanata did not differentially bioaccumulate Al, Zn, or Cd in soft tissues from any of the three streams. Therefore, E. complanata did not provide a practical tool to monitor the concentration or speciation of Al, Zn, or Cd during these episodic events. (Main-PTT)
W88-00080

COPPER ACTIVITY IN SOIL SOLUTION: I. MEASUREMENT BY ION-SELECTIVE ELECTRODE AND DONNAN DIALYSIS,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
M. M. Minnich, and M. B. McBride.
Soil Science Society of America Journal SSJD4, Vol. 51, No. 3, p 568-572, May-June 1987. 3 fig, 3 tab, 28 ref.

Descriptors: *Soil chemistry, Pollutant identification, *Copper, *Ion-selective electrodes, *Donnan dialysis, Anodic stripping voltammetry, Cation-exchange membranes, Metal buffering, Sludge, Soil solutions, Saturation extracts, Ion-selective electrodes.

Copper activity in saturation extracts of sludge- and Cu-salt-treated soil was estimated by ion-selective electrode (ISE) and by Donnan dialysis. Treatments were a factorial combination of four levels of Cu additions and four levels of total sludge additions. In the Donnan system, the ionic strength of a soil saturation extract was matched with KOAc buffer on opposite sides of a cation permselective membrane. At membrane equilibrium, Cu concentration was determined in the KOAc buffer by voltammetry. Extracts of sludge treatments had sufficient Cu buffering capacity to maintain the same Cu(2+) activity before and after dialysis. Cu-salt treatments exhibited a lower soil solution Cu(2+) activity after dialysis indicating the procedure was inadequate for these treatments. The ISE results were more precise, but the technique is only suited for use in aerobic, Cu-contaminated soils. Values for Cu(2+) activity obtained by ISE were approximately an order of magnitude grater than Cu(2+) activity values estimated by the Donnan dialysis method. By either procedure, increased total Cu resulted in higher Cu(2+) activities. Total soluble Cu was highest in the Cu-salt treatment. Sludge rate was associated with increased soluble Cu and a decreased proportion of free Cu(2+). Although the ISE gave more precise results (lower CU), the accuracy of the methods can only be evaluated by comparing the results to those of trusted procedures. (See also W87-12190) (Author's abstract)
W88-00104

COPPER ACTIVITY IN SOIL SOLUTION: II. RELATION TO COPPER ACCUMULATION IN YOUNG SNAPBEANS,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
M. M. Minnich, M. B. McBride, and R. L. Chaney.
Soil Science Society of America Journal SSJD4, Vol. 51, No. 3, p 573-578, May-June 1987. 3 fig, 3 tab, 28 ref.

Descriptors: *Soil chemistry, Pollutant identification, *Copper, *Soil solutions, *Snapbeans, *Sewage sludge, Ion-selective electrodes, Donnan dialysis, Plant ion uptake, Trace metals, Hydrogen ion concentrations, Zinc, Crop yield.

Soil solution Cu(2+) activity measured in soil saturation extracts was compared with Cu accumulation in young snapbeans. Copper was supplied through sewage sludge mixtures of varied Cu concentrations and through Cu-salt additions in the soil. Treatments were factorial combinations of four levels of Cu additions and four levels of total sludge additions. Soil and sludge pH values were limited to pH 5.0 and 5.5. Plant yield differences were minor. Data are reported showing the relationships of root, shoot, and total plant Cu contents with Cu(2+) activity, DTPA-extractable Cu, soluble Cu, and sludge Cu concentration. The Cu source (sludge vs. salt) produced distinctly different curves in most cases. Sludge treatments demonstrated nonlinear relationships of Cu activity vs. Cu accumulation; these were fit with exponential functions. Higher shoot Cu concentrations occurred with the Cu salt treatments. Higher root Cu levels occurred at lower Cu(2+) activity values with sludge as the Cu source. Total soluble Cu was not related to plant Cu. Root Cu levels also reflected the proportion of Cu in the sludge, but higher sludge rates resulted in increased root Cu. Increased labile, soluble, Cu-organic complexes with increased sludge rates would explain both the observed difference between salt and sludge treatments and the positive correlation of root Cu and sludge rate. Physiological control of Cu translocation within the plant is implicit in this reasoning. Continual monitoring of soil solution ion activity or buffering index is needed to improve predictions of plant ion uptake. (See also W87-12189) (Author's abstract)
W88-00105

SIMPLIFIED WET-ONLY AND SEQUENTIAL FRACTION RAIN COLLECTOR,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-00121

RELATIONSHIP BETWEEN ENVIRONMENTAL FACTORS, YEASTS AND COLIFORMS IN THE YODO RIVER,
Kinki Univ., Higashiosaka (Japan). Dept. of Agricultural Chemistry.
T. Fujita, S. Komemushi, and K. Yamagata.
Journal of Fermentation Technology JFTED8, Vol. 65, No. 2, p 193-197, April 1987. 5 fig, 1 tab, 18 ref.

Descriptors: *Pollutant indentification, *Bioindicators, *Pollution load, *Yeasts, *Coliforms, *Microbial populations, Pollutants, Correlation coefficient, Temperature, Hydrogen ion coefficient, Dissolved oxygen, Chemical oxygen demand, Biological oxygen demand, Nitrogen compounds, Phosphorus compounds, Yodo River.

The relationship between microbial populations, the number of yeasts, bacteria and coliforms, and temperature, pH, DO, COD, BOD, NH4-N, NO2-N, NO3-N and Total-P was investigated by using 12 water samples collected from four stations on the Yodo River, Osaka, Japan. Total yeast counts had a positive response to increased pollution of NH4-N and Total-P in water. There were significant positive correlations between the size of the yeast population and the concentration of some nutrients, with total phosphate Pearson's correlation coefficient r=0.780 ($p<0.01$) and NH4-N Spearman's correlation r=0.515 ($p<0.10$). The number of yeast cells are also correlated with that of coliforms (r=0.911, $p<0.01$) at all stations except the estuary one. Traditionally, coliforms in water have been used as an indicator of the extent of water pollution, but yeast can be a better indicator when the water includes an area susceptible to saltwater. (Author's abstract)
W88-00150

AUTOMATED WATER-QUALITY MONITORING,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
K. Nishioka.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 661-677, 4 fig, 6 tab, 8 ref.

Descriptors: *Monitoring, *Wastewater analysis, Wastewater management, Bacterial analysis, Chemical analysis, Physical analysis, Computer models, Model studies, Computer programs.

Automated monitoring is necessary if the supply of high-quality (potable) water is to be maintained at a reasonable cost. This paper provides some insight into automated water quality monitoring using current technology. An overall experimental system is described which includes collection of samples, and measurement of turbidity, dissolved oxygen, total organic carbon, pH, ammonia, chloride, nitrate, conductivity, temperature, sodium, residual chlorine, hardness, coliforms and halo-carbons. Problems that may occur, such as electrical and mechanical failures, complex control-logic difficulties with computer software, and crosswiring of sensors are discussed. Because the benefits of automated water quality monitoring can only be fully realized when data are used in real-time control of a water-processing plant, a description of how this might be accomplished is provided. (See also W88-00164) (Halterman-PTT)
W88-00192

ALGAE AS ECOLOGICAL INDICATORS.
North Dakota Univ., Grand Forks. Dept. of Biology.
Academic Press, New York, NY. 1984. Edited by L. Elliot Shubert. 434 p.

Descriptors: *Algae, *Bioassay, *Assay, *Environmental effects, Monitoring, Water pollution effects, Phytoplankton, Microcosm studies, Vitamins, Model studies, Aquatic productivity, Algal growth, Bioaccumulation, Heavy metals, Eutrophication, Thermal pollution.

In this collection of papers, the importance of algae as ecological indicators is detailed, past and current research in the field is described, and suggestions for future research are made. Topics covered include: indicator algal assays for both freshwater and marine ecosystems; the effect of environmental contamination on aquatic algae; algae as monitors of heavy metals; algal assays for vitamins; use of algal bioassay to evaluate industrial and energy process effluent; the biological monitoring of algal communities; and studies on the effects of increased temperatures on phytoplankton. Specific laboratory and in situ laboratory techniques are described, and their advantages and disadvantages are considered. The unique role that algal bioassay can play in water quality studies is emphasized, and it is pointed out that the application of algae as ecological indicators is diverse, both in habitat type and ecological parameters. (See W88-00197 thru W88-00207) (Halterman-PTT)
W88-00196

INDICATOR ALGAL ASSAYS: LABORATORY AND FIELD APPROACHES,
Connecticut Univ., Storrs. Biological Sciences Group.
F. R. Trainor.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 3-14, 6 tab, 22 ref.

Descriptors: *Bioassay, *Assay, *Algae, Water quality, Nitrogen, Field tests.

Studies related to the use of some algal species as indicators of water quality are reviewed, and the relative merits of field and laboratory studies are considered. Suggestions for future research (including development of a continuous culture procedure and selection of a universally appropriate indicator species) are described. It is shown that neither the Chlamydomonas species tested nor Scenedesmus AP 1 can be used as reliable indicators of nitrogen levels in field studies. New methods developed for field incubation studies (employing dialysis sacs) and for laboratory algal assays are presented. It is pointed out that the sensitive algal assay procedure used in the laboratory eliminates the problem of nutrient carry-over in the medium, by use of a weak nutrient solution. Problems with applying the abundant laboratory data to understanding the functioning of organisms in nature are also explained. (See also W88-00196) (Halterman-PTT)
W88-00197

IN SITU AND NATURAL PHYTOPLANKTON ASSEMBLAGE BIOASSAYS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. L. Schelske.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 15-47, 6 fig, 106 ref.

Descriptors: *Algae, *Bioassay, *Environmental effects, Ecological effects, Phytoplankton, Nutrients, Eutrophication, Algal growth, Aquatic productivity.

Studies of algal assays or bioassays of algal responses to different environmental perturbations are reviewed. Both in situ and laboratory approaches using natural phytoplankton assemblages are included. Types of enclosures used for in situ studies (bottles, bags, tubes, curtains and flow-through cages) and types of experiments (spike, fixed level or fixed supply, dilution, chemostat and turbidostat) are described. A discussion of the design of experiments focuses on the levels of nutrients used in enrichment studies, appropriate use of controls, and the importance of such factors as depth and time of sampling, as well as whether or not zooplankton are present. The choice of variable to measure is dependent on the purpose of the study; however, a brief description is presented for many possibilities, including chlorophyll a, cell counts, species composition, biomass, carbon uptake, and a variety of physiological indicators. Finally, the practical applications and general considerations of in situ and laboratory bioassays are discussed. (See also W88-00196) (Halterman-PTT)
W88-00198

QUALITATIVE CHARACTERISTICS OF PHYTOPLANKTON ASSEMBLAGES,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
E. F. Stoermer.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 49-67, 117 ref.

Descriptors: *Phytoplankton assemblages, *Algae, Ecological effects, Aquatic plants, Eutrophication, Aquatic productivity, Algal growth.

Scientists generally tend to strive for quantitative measurement of phenomena; however, aquatic ecologists are sometimes forced to deal with qualitative information. The purpose of this paper is to review the qualitative characteristics of phytoplankton assemblages. First, however, cases are discussed in which qualitative data on phytoplankton are useful. These cases fall within the category of indicator species; that is, the presence or absence of certain species indicate possible environmental conditions. The methodologies for data synthesis and interpretation are then reviewed. Algal nomenclature, data acquisition and data storage are discussed, with several useful examples presented. Finally, the need for an effort to interface population data with quantitative data is stressed. Application of the various techniques for doing so will provide significant insights into the function of biological communities, and, hopefully, bridge the gap between purely qualitative and quantitative approaches. (See also W88-00196) (Halterman-PTT)
W88-00199

ALGAL ASSAYS FOR VITAMINS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
D. G. Swift.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 281-313, 9 fig, 6 tab, 107 ref.

Descriptors: *Bioassays, *Vitamins, Ecological effects, Aquatic plants, Aquatic productivity, Algal growth, Vitamin B, Thiamine, Biotin.

Many algae require vitamins at low external concentrations and function as co-factors in biochemical pathways. The biological response to vitamins for these algae includes cell yield and growth rate. Because of these properties (algal-vitamin interaction), it is possible to use algal bioassays to determine the concentrations of vitamins in natural waters. This paper serves as a review of various physical and chemical properties of vitamins, their occurrence in natural waters, their importance in algal growth, and methodologies by which assays are performed. Specific topics of discussion include the structure and properties of vitamins; the basic features of algal bioassays for vitamins; the types of standard curves and problems with standards; organisms used for bioassays; inhibition and non-specific responses; chemical methods; ecological aspects of vitamins in aquatic habitats; vitamin concentrations in various regions; and approaches for ecological studies pertaining to the role of vitamins in water. (See also W88-00196) (Halterman-PTT)
W88-00200

USE OF SEAWEEDS FOR MONITORING COASTAL WATERS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
H. G. Levine.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 189-210, 4 fig, 179 ref.

Descriptors: *Algae, *Monitoring, *Aquatic plants, *Water pollution effects, Ecological effects, Aquatic productivity, Algal growth.

In recent years the use of seaweeds to monitor pollution has increased, and this paper is a guide to the variety of approaches developed for their use as bioindicators of pollution at the species level. Two examples of basic monitoring approach are laboratory testing for detrimental effects of compounds on the biota, and monitoring for the presence of pollutants. Macrophytic algae are impor-

tant ecologically, as they constitute a significant portion of the food web base in coastal waters. They also integrate the history of a water mass over prolonged periods of time through the process of bioaccumulation. Intrinsic advantages that macrophytes have with regard to monitoring are reviewed. The attached seaweeds can be used to characterize coastal water quality at one site over time. They take nutrients and other chemicals directly from the water, they are unable to avoid pollutants, and they can be propagated asexually. Work is currently being conducted to couple microbial mutagenicity assays to tissue extracts for seaweeds which have bioaccumulated potentially mutagenic materials. (See also W88-00196) (Halterman-PTT)
W88-00201

EFFECT OF ENVIRONMENTAL CONTAMINANTS ON AQUATIC ALGAE,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W88-00202

ALGAE AS MONITORS OF HEAVY METALS IN FRESHWATERS,
Durham Univ. (England). Dept. of Botany.
B. A. Whitton.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 257-280, 1 fig, 3 tab, 35 ref.

Descriptors: *Algae, *Monitoring, *Heavy metals, Bioaccumulation, Bioassays, Ecological effects, Aquatic plants, Water pollution effects, Pollutants.

Methodologies and examples of studies in which algae were used to monitor heavy metals in freshwaters are reviewed. None of the approaches used has yet been developed so well that it can be applied routinely for water management purposes. Many studies of heavy metal pollution appear to have made use of algae more because of the particular interest of the researchers than because algae were obviously the most suitable organism for the project. The need to develop standard methods is stressed. Two promising possibilities exist: first, development of a set of assays parallel to those developed for predicting and interpreting nutrient eutrophication; and second, the use of metal content in field populations to monitor events in water bodies which could be used routinely, especially in flowing waters. (See also W88-00196) (Halterman-PTT)
W88-00203

UTILIZATION OF ALGAL CULTURES AND ASSAYS BY INDUSTRY,
Minnesota Mining and Mfg. Co., St. Paul. Environmental Lab.
M. T. Elnabarawy, and A. N. Welter.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 317-328, 3 tab, 39 ref.

Descriptors: *Algae, *Bioassays, *Ecological effects, Aquatic plants, Eutrophication, Aquatic productivity, Algal growth, Water pollution effects, Monitoring, Pollutants, Industrial wastes, Effluents, Costs, Wastewater treatment.

In the past decade, significant environmental legislation has been enacted which addresses the control of industrial wastes and/or chemical substances which might be associated with an increased risk to human health and/or the environment. Possible uses of algae by industry to assess the environmental impact of new chemical substances or to monitor wastes which may enter the aquatic environment are outlined. The use of algae as biological indicators is reviewed. A discussion of the utilization of algal systems by industry includes the role of algae in assessment of water quality, the stimulatory or inhibitory effects of effluent discharges, algal assay of chemical substances, biological treatment of wastewaters, and the cost of algal assays. Future research which is needed to facilitate the analysis and interpretation of data presently being gathered is summarized. (See also W88-00196) (Halterman-PTT)
W88-00204

ALGAL BIOASSAYS OF INDUSTRIAL AND ENERGY PROCESS EFFLUENTS,
Environmental Research Lab., Gulf Breeze, FL.
G. E. Walsh, and R. G. Merrill.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 329-360, 5 fig, 7 tab, 122 ref.

Descriptors: *Algae, *Bioassays, *Ecological effects, Pollutants, Monitoring, Water pollution effects, Aquatic plants, Eutrophication, Aquatic productivity, Algal growth, Industrial wastes, Effluents.

A large amount of evidence indicates that industrial and energy process effluents contain algal and animal toxicants and algal growth stimulators. Algae respond in an easily measurable way to substances that affect productivity. This paper presents a review of studies and their interpretation with regard to effects of complex wastes on marine and freshwater unicellular algae. A search should be made for new species for use in toxicity tests because the widely-used Selenastrum capricornutum may not be one of the more sensitive species. Several algal species should be used because there is not a single most sensitive species. The batch method is the most common technique, but mixed-species continuous culture presents a more realistic approach. Finally, algae respond to both growth stimulants and growth inhibitors, and the stimulation response occurs at concentrations much lower than those that inhibit growth. (See also W88-00196) (Halterman-PTT)
W88-00205

SYNTHETIC MICROCOSMS AS BIOLOGICAL MODELS OF ALGAL COMMUNITIES,
Washington Univ., Seattle. Coll. of Ocean and Fishery Sciences.
For primary bibliographic entry see Field 5C.
W88-00206

SIMULATING THE EFFECTS OF INCREASED TEMPERATURE IN A PLANKTON ECOSYSTEM: A CASE STUDY,
Washington Univ., Seattle. Center for Quantitative Science.
For primary bibliographic entry see Field 5C.
W88-00207

MEASUREMENT OF WATER QUALITY,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
IN: Environmental Pollution and Control, 2nd edition. Butterworth, Boston, MA. 1983. p 35-55, 7 fig, 1 tab.

Descriptors: *Pollutant identification, *Water analysis, Sampling, Water quality, Oxygen, Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand, Organic carbon, Turbidity, Color, Odor, Hydrogen ion concentration, Suspended solids, Nitrogen, Phosphates, Bacterial analysis.

Some of the analytical tests for water pollutants are discussed. Sampling is an important aspect of pollutant analysis. Dissolved oxygen can be quantified by an oxygen probe or the Winkler test. The test for biochemical oxygen demand measures the potential oxygen demand of a sample. Dissolved oxygen is determined on each day of the BOD test, usually run in the dark at 20 C for 5 days using a standard bottle. Chemical oxygen demand values, always higher than BOD values, are determined by oxidation with potassium dichromate. The excess is measured by adding a reducing agent, usually ferrous ammonium sulfate. Total organic carbon, which indicates the ultimate transformation of organic matter into carbon dioxide, requires expensive instrumentation. The Jackson Candle Turbidimeter of 1900 or electronic methods can measure turbidity. Color is measured against color standards; odor, by subjective means. pH, a measure of hydrogen ion concentration, is presently determined by electronic devices. Total solids, dissolved solids, and suspended solids are trapped for measurement by filtering the water sample through a Gooch crucible. Methods for determining nitrogen depend on the chemical form present in the sample. The Kjeldahl nitrogen test measures total nitrogen. Other forms of nitrogen–ammonia, nitrate, and nitrite–can be indicated by colorimetric techniques. Phosphate analysis involves sample processing, then colorimetry. Bacteriological pollutants are detected by incubating a filtrate in a Petri dish, then examining it for colonies of indicator organisms, often coliforms. (See also W88-00314) (Cassar-PTT)
W88-00332

AMOCO CADIZ ANALYTICAL CHEMISTRY PROGRAM,
Energy Resources Co., Inc., Cambridge, MA.
For primary bibliographic entry see Field 5B.
W88-00381

STUDIES OF HYDROCARBON CONCENTRATIONS AT THE ILE GRANDE AND BAOE DE LANNION STATIONS POLLUTED BY THE WRECK OF THE AMOCO CADIZ,
Centre National de la Recherche Scientifique, Marseille (France). Lab. de Chemie Organique.
H. Dou, G. Giusti, and G. Mille.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p 101-109, 2 fig, 3 tab.

Descriptors: *Sediments, *Marshes, *Fate of pollutants, *Biodegradation, *Oil spills, *Oil pollution, Oil, Hydrocarbons, Petroleum products, Pollutant identification, Marine sediments, Bottom sediments, Organic compounds.

A study was made of the hydrocarbon concentrations in sediments of the Ile Grande and Baie de Lannion stations polluted by the AMOCO CADIZ oil spill. Samples were collected at sites A, D, and F located in a very polluted zone, and B, C, and E located in a zone protected from the oil slick by a dam. Samples were collected in December 1978, March 1979, November 1979, and May 1980 using a plexiglass corer. The samples were analyzed by systematic soxhlet extraction following Farrington's method. Results showed that the weight of the compounds before saponification and after saponification may be used to characterize the capacity of the medium to be biodegraded. The fraction FB (separated by Sep-Pak and hydrochloric acid elution) is constituted by unsaponifiable compounds. When biodegradation increases, the FB fraction decreases. In very polluted zones, the concentrations of hydrocarbons were about null in 1980, but complex organic compounds of heavy molecular weight, which are extractable with haxane remain in the sediment. In general, the less polluted zones are returning to a normal state, but a seemingly important residue remains in very polluted sites after linear, substituted, and light aromatic hydrocarbons have disappeared. (See also W88-00363) (Geiger-PTT)
W88-00382

EVOLUTION OF THE HYDROCARBONS PRESENT IN THE SEDIMENTS OF THE ABER WRAC'H ESTUARY,
Institut Francais du Petrole, Rueil-Malmaison.
For primary bibliographic entry see Field 5B.
W88-00383

GLOBAL WATER QUALITY MONITORING,
Canada Centre for Inland Waters, Burlington (Ontario).
S. Barabas.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. Edited by Lawrence H. Keith. p 481-494, 1 fig, 3 tab.

Descriptors: *Water quality, *Environmental protection, *Water pollution control, *Water quality management, Pollutant identification, Monitoring, Environmental quality, Environmental policy, Network design, Water analysis, Networks, Hydrologic data collections.

Three main factors affect the availability and quality of freshwater on earth: the size of the earth's

population; its geographic distribution; and the state of industrialization and urbanization of the peoples on earth. The per-capita consumption of water has increased with the gross national product. Public awareness of man's abuse of the environment has been a gradual process. At the United Nations Conference held in Stockholm, Sweden in June 1972, representatives of 113 nations agreed on a broad plan of action to control environmental pollution. An environmental assessment faction known as Earthwatch set up to the GEMS program to monitor pollutants in air, water, soil, food and biota. The GEMS/WATER project is responsible for monitoring the incidence and trends of pollutants in water, providing advance warning of any serious deterioration, and prompting governments to initiate, individually and/or collectively, corrective action for the protection, restoration and improvement of the environment. The GEMS/WATER program has set up a monitoring network of approximately 300 monitoring stations on rivers, lakes and aquifers in a limited number of countries. In addition, a pilot project reporting water quality data from advanced countries was initiated, and a training course was established for less developed countries. (See also W88-00406) (Geiger-PTT)
W88-00407

COMPUTER SURVEY OF GAS CHROMATOGRAPHY/MASS SPECTROMETRY DATA ACQUIRED IN THE U.S. ENVIRONMENTAL PROTECTION AGENCY SCREENING ANALYSIS: SYSTEM AND RESULTS,
Environmental Research Lab., Athens, GA.
W. M. Shackelford, D. M. Cline, L. Burchfield, L. Faas, and G. Kurth.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. Edited by Lawrence H. Keith. p 527-554, 10 fig, 11 tab, 11 ref.

Descriptors: *Organic compounds, *Computer programs, *Gas chromatography, *Mass spectrometry, *Wastewater analysis, Data collections, Computers, Industrial wastes, Networks, Pollutant identification, Automation, Surveys.

In June 1976, the U.S. Environmental Protection Agency was charged with the responsibility of assessing the wastewater of 21 industrial categories for 65 chemical substances and prescribing the best available treatment for the effluent. To inventory and track the 20,000 GC/MS data runs and the estimated 12,000 extracts, a data base management system, INFORM, was implemented. The system consists of four main parts: the internal standard locator, PESL; the peak or spectrum extractor, CLEANUP; the spectrum matching system, PBM; and the result collator, HISLIB. Reporting is accomplished by hard copy outputs or graphical methods. Results of data generated thus far indicate that for the systems studied, automated techniques are at least equal to manual techniques for pointing out components in the run and identifying them by spectrum matching with a reference library. Two areas are still being studied. The proper compensation of background by CLEANUP is of concern since errors in intensity calculations reduce the chance that PBM (the spectrum matching system) will find a match for the spectrum. A second area of concern is the inflexibility of certain CLEANUP parameters. The automatic setting of these parameters during data processing is desirable and is presently under study. (See also W88-00406) (Geiger-PTT)
W88-00409

OVERCOMING BOTTLENECKS IN ENVIRONMENTAL SAMPLE ANALYSIS,
Finnigan Corp., Sunnyvale, CA.
R. E. Finnigan, M. S. Story, and D. F. Hunt.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 555-570, 7 fig, 1 tab, 7 ref.

Descriptors: *Gas chromatography, *Organic compounds, *Mass spectrometry, *Pollutant identification, Water analysis, Wastewater analysis, Automation, Computers, Chromatography, Drinking water, Industrial wastes, Training.

Following the adoption of gas chromatography/mass spectrometry (GC/MS) by EPA labs as the principal tool for the identification and analysis of organic pollutants in water in 1971, this technique was adopted as the main method for analysis of drinking water, effluent streams from industrial plants, and organics in the air and hazardous wastes. By the end of the 1970's, many industries in the United States and western Europe had adopted GC/MS for the analysis of their own effluents. Despite its success, GC/MS has encountered several limitations in environmental analysis. The complexity of GC/MS systems requires qualified technical personnel to operate and maintain them. High initial cost of GC/MS with associated data systems implies a higher cost for sample analysis when compared to other methods such as GC only. GC/MS encountered limitations when analyzing complex environmental matrices such as sludges and soils, and very low level complex isometric pollutants such as TCDD. The organics in water analyzer (OWA) is a fully automated compact GC/MS system designed specifically for routine and repetitive analysis of volatile and dissolved organic pollutants in water. Automation of the OWA is accomplished using a dedicated minicomputer. MS/MS provides a technique which is faster, often shows higher specificity, is less destructive to the sample and is capable of analyzing some samples not amendable to GC/MS analysis. (See also W88-00406) (Geiger-PTT)
W88-00410

APPLICATIONS OF A DATA-ADAPTIVE BACKGROUND SUBTRACTION TECHNIQUE TO THE GAS CHROMATOGRAPHIC/MASS SPECTROMETRIC ANALYSIS OF WASTEWATER SUPPLIES,
Computer Sciences Corp., Falls Church, VA.
A. D. Sauter, L. Faas, G. R. Kurth, W. M. Shackelford, and D. M. Cline.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 571-593, 10 fig, 3 tab, 12 ref.

Descriptors: *Gas chromatography, *Organic compounds, *Mass spectrometry, *Computers, *Pollutant identification, Wastewater analysis, Automation, Chromatography, Industrial wastes, Polychlorinated biphenyls, Surveys, Industrial wastewater.

A preprocessor was added to a computer survey system to seek out the industrial standard used in GC/MS analyses of organic pollutants in industrial wastewater samples. A background correction technique utilizes a 'piecewise' least-squares fit approach to estimate the local background in spectrum number ranges. Extracted ion current profiles (EICP) are divided into sequences which are further divided into intervals. The number of intervals (NUMINT) and the number of spectra in an interval (NUMSCAN) are user-defined variables employed in this technique. The optimum value of these user-defined variables is peak geometry-dependent. After the best background line has been removed from the raw data, detection of the peak representing the component is initiated. Intensity distributions of background-corrected EICP were examined to derive an alternative threshold-setting procedure. A simplistic peak detection algorithm is used to point to the location of the sought components. To demonstrate the ability of the approach to locate the internal standard where CLEANUP/PBM had failed, hundreds of such data files were run through the preprocessor. The preprocessor located the internal standard in 90% of these data files in agreement with their manually assigned retention time. Usefulness of the preprocessor in examining large volumes of GC/MS data is illustrated in studies on the location of chlorinated biphenyls. (See also W88-00406) (Geiger-PTT)
W88-00411

COMPARISON OF GROB CLOSED-LOOP STRIPPING ANALYSIS WITH OTHER TRACE ORGANIC METHODS,
Health Effects Research Lab., Cincinnati, OH.
R. G. Melton, W. E. Coleman, R. W. Slater, F. C. Kopfler, and W. K. Allen.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 597-673, 10 fig, 10 tab, 39 ref.

Descriptors: *Gas chromatography, *Organic compounds, *Mass spectrometry, *Pollutant identification, *Comparison studies, Chromatography, Water analysis, Drinking water, Trace levels, Reviews, Activated carbon.

This report reviews the U.S. purge-and-trap (P&T) methods for the analysis of purgeable organics in drinking water and presents some comparative analytical data of surface water samples (Cincinnati tapwater before and after granular activated carbon treatment) using the Bellar purge and trap analysis, the Grob capillary GC/MS data system closed-loop stripping analysis (GC/MS/DS CLSA) the batch liquid-liquid extraction (BLLE) analysis using a modified Master Analytical Scheme (MAS) procedure, and the XAD-2 adsorption-ethyl ether elution method (XAD-EEE). Data presented suggest that the combined use of the Bellar P&T Method and Grob capillary GC/MS CLSA measures a number of organics that the MAS P&T method and MAS XAD-4 adsorption method cannot measure. The combined use of the Bellar P&T Method and the described Grob CLSA and BLLE procedure will measure a considerably greater number of organics in drinking water than the combined use of the MAS P&T and MAS XAD-EEE procedures. Experimental data on samples of drinking water indicate that twice as many Consent Decree organics and 'chemical indicators of industrial pollution' were detected and quantified by Grob CLSA than by Bellar P&T, BLLE and XAD-EEE analysis. Grob CLSA produced this superior analysis at a low cost-per-compound-analyzed figure. (See also W88-00406) (Geiger-PTT)
W88-00412

AUTOMATIC QUANTIFICATION AND STATISTICAL EVALUATION OF ORGANIC CONTAMINANTS USING A COMPUTERIZED GLASS CAPILLARY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SYSTEM AND GROB CLOSED-LOOP STRIPPING,
Health Effects Research Lab., Cincinnati, OH.
W. E. Coleman, W. K. Allen, R. W. Slater, S. J. Voto, and R. G. Melton.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 675-688, 5 fig, 3 tab, 6 ref.

Descriptors: *Gas chromatography, *Organic compounds, *Mass spectrometry, *Automation, *Pollutant identification, Water analysis, Computers, Chromatography, Statistical analysis, Activated carbon.

To validate Grob closed-loop-stripping analysis (CLSA) as a method for concentrating organics from water samples and subsequently to provide qualitative and quantitative analyses of the Grob carbon filter extracts by glass capillary GC/MS/DS (data system), ten repetitive glass capillary GD/MS/DS analyses of the direct injections of a 22-compound standard mixture were performed to establish sets of average relative retention times (RRT) and response factor (RF) values for each compound. These values were stored in a computerized quantification library. Statistical computations on RRT, GC peak areas, RF, amounts and recovery efficiencies by CLSA have shown that glass capillary GC/MS analyses followed by computerized automatic quantification procedures employing MS single-ion quantification (SIQ) based on the internal standard, can be used to quantify nanogram/liter-level results of CLSA within + or - 15% accuracy. Reproducible RRT and RF were mainly attributed to stable and reproducible glass capillary GC/MS/DS operating conditions, constant linear velocity through the GC column and constant ion source pressure. The data show that library RF should not be reproducible, but computer-calculated relative RF should be linear in the

concentration range being analyzed. (See also W88-00406) (Geiger-PTT)
W88-00413

DEVELOPMENT OF A CLOSED-LOOP STRIPPING TECHNIQUE FOR THE ANALYSIS OF TASTE- AND ODOR-CAUSING SUBSTANCES IN DRINKING WATER,
Southern California Metropolitan Water District, La Verne. Water Quality Branch.
S. W. Krasner, C. J. Hwang, and M. J. McGuire.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 689-710, 8 fig, 12 tab, 35 ref.

Descriptors: *Pollutant identification, *Taste, *Odor, *Gas chromatography, *Mass spectrometry, Water analysis, Bottom sediments, Lake sediments, Bacteria, Organoleptic properties, Organic compounds.

Several compounds such as geosmin produced by Actinomycetes impart a taste or odor to water. Often these compounds are difficult to identify and quantify at low levels. A method has been developed by the Metropolitan Water District of Southern California for the determination of several taste- and odor-causing substances in water, sediments, and cultures using the Grob closed-loop stripping analysis (CLSA) gas chromatography/mass spectrometry (GC/MS) technique. The CLSA-GC/MS method was applied to analysis of Colorado River water and reservoirs of the Metropolitan Water District system following consumer complaints of taste and odor in drinking water. The results of the analyses allowed management decisions to be made which helped to alleviate the problems. CLSA-GC/MS coupled low detection limits with manageable sample size and quick analysis time. CLSA-GC/MS provides a valuable tool for extended surveys and regular monitoring of water supplies, identification of other taste- and odor-causing compounds, and evaluation of bench-scale and pilot-plant treatment processes at the nanogram/L level. (See also W88-00406) (Geiger-PTT)
W88-00414

SCHEME FOR THE ROUTINE ANALYSIS OF PURGEABLE COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY,
Environmental Protection Agency, Cincinnati, OH. Office of Drinking Water.
D. J. Munch, J. W. Munch, M. A. Feige, E. M. Glick, and H. J. Brass.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 713-728, 6 fig, 4 tab, 16 ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Mass spectrometry, *Drinking water, *Organic compounds, Water analysis, Computers, Chromatography, Automation, Trace levels.

A scheme was developed for the routine gas chromatography/mass spectrometry (GC/MS) analysis of purgeable compounds in drinking water and water supply sources. The procedure uses purge-and trap sample concentration followed by GC/MS analysis. Data reduction is performed by a computerized GC/MS data system. The quantification limits, precision and accuracy of these analyses have been demonstrated to be comparable to gas chromatography coupled with electrolytic conductivity and flame ionization detection. The analytical scheme permits the routine qualitative and quantitative analysis of 16 commonly occurring purgeable compounds over a concentration range of 0.1-0.2 to 0.5 micrograms/liter. Additional compounds can be analyzed by incorporating appropriate analytical standards. (See also W88-00406) (Geiger-PTT)
W88-00415

ANALYSIS OF VOLATILE ORGANICS ON SEDIMENTS AND IN ASSOCIATED WATER,
Environmental Research Lab., Athens, GA.
J. Ellington.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 729-746, 9 fig, 4 tab, 12 ref.

Descriptors: *Gas chromatography, *Mass spectrometry, *Pollutant identification, *Bottom sediments, *Organic compounds, Separation techniques, Lake sediments, Water analysis, Chromatography.

Initial attempts at describing organics from sediments prior to analysis by gas chromatography/mass spectrometry (GC/MS) are described. Methods of desorption include purging and solvent extraction. The Grob closed-loop stripping analysis (CLSA) method offers several advantages over conventional purge-and-trap and microsolvent extraction techniques. In a closed system, substances that break through the filter are automatically recycled. A small volume of gas is constantly recycled through the filter. Stripping methods are not as strongly influenced by matrix effects of the water. The CLSA method is broader in scope and can be performed at higher temperatures. Elevated temperature stripping of sediments gave a 100-fold concentration of a monoester (TMI) compared to that obtained with soxhlet extraction. The low amount of TMI found in the associated water indicates a high partition from water to sediment. Radiolabeled compounds were useful in determining optimum extraction conditions. CLSA at elevated temperature, coupled with solvent extraction for less volatile compounds, should serve as an appropriate screening scheme for a broad spectrum of organic compounds in sediments. (See also W88-00406) (Geiger-PTT)
W88-00416

ORGANIC ANALYSES USING HIGH-TEMPERATURE PURGE-AND TRAP TECHNIQUES,
Radian Corp., Austin, TX.
R. L. Spraggins, R. G. Oldham, C. L. Prescott, and K. J. Baughman.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 747-761, 3 fig, 8 tab, 9 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Wastewater analysis, *Solid wastes, *Separation techniques, Sludge, Water analysis, Soil analysis, Gas chromatography, Mass spectrometry, Sediments.

A method was developed for analyzing semi-solid and solid matrix samples including soil, sludge and sediments for volatile organics using purging at elevated temperatures. The samples analyzed in the present study included water samples, soil from a petroleum landfarming site, solid waste samples from a chemical dumping area, and an oily sludge from petroleum processing. The high-temperature purging of volatiles from a sample matrix is done with an inert purge gas. The volatiles are trapped from the purge gas onto a solid sorbent, and then are thermally desorbed onto an analytical system for analysis. The detection limits for volatile organics in solid samples are improved, usually by two-orders of magnitude, using dynamic headspace techniques compared to static headspace analysis. The dynamic headspace technique will permit environmental monitoring of many volatile organics in semi-solid and solid matrix samples at the 1 part/billion level. Careful sample preparation is required to achieve reproducible results. (See also W88-00406) (Geiger-PTT)
W88-00417

DEVELOPMENT OF METHODS FOR THE ANALYSIS OF PURGEABLE ORGANIC PRIORITY POLLUTANTS IN MUNICIPAL AND INDUSTRIAL WASTEWATER TREATMENT SLUDGES,
Midwest Research Inst., Kansas City, MO.
C. L. Haile, Y. A. Shan, L. S. Malone, and R. V. Northcutt.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 763-791, 14 fig, 10 tab, 5 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Mass spectrometry, *Gas chromatography, *Sludge, Wastewater analysis, Industrial wastewater, Municipal wastewater, Solid wastes.

A method was devised for the analysis of purgeable organic priority pollutants in sludges generated by the treatment of municipal and industrial wastewaters. Sludge samples were stored at 4 C with no headspace and spiked with organic compounds. Three purge hardware systems (stirred purging and dynamic headspace systems configured from a round-bottom flask and a stirred bottom frit tube) were evaluated. The addition of salt or a high-boiling hydrophilic organic compound to sludge aliquots prior to purging was examined as a means of enhancing the purging efficiencies of volatile compounds. The stirred bottom frit tube gave recoveries for compounds spiked into undiluted sludge and analyzed by GC/MS that were as good as or better than the recoveries from dilution followed by purge-and-trap GC/MS with the conventional purge tube. The precision of recovery measurements was much better with the bottom frit tube, and no foaming problems were observed. No specific advantages from adding salt or ethylene glycol were apparent. (See also W88-00406) (Geiger-PTT)
W88-00418

DEVELOPMENT OF METHODS FOR THE ANALYSIS OF EXTRACTABLE ORGANIC PRIORITY POLLUTANTS IN MUNICIPAL AND INDUSTRIAL WASTEWATER TREATMENT SLUDGES,
Midwest Research Inst., Kansas City, MO.
V. Lopez-Avila, C. L. Haile, P. R. Goddard, L. S. Malone, and R. V. Northcutt.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 793-828, 8 fig, 11 tab, 11 ref.

Descriptors: *Pollutant identification, *Sludge, *Chromatography, *Organic compounds, Wastewater analysis, Gas chromatography, Mass spectrometry, Gels, Industrial wastewater, Municipal wastewater, Solid wastes.

Research to develop methods for the analysis of organic priority pollutants in municipal and industrial wastewater treatment sludges was conducted in two stages. First, a preliminary sludge analysis protocol was developed from existing wastewater methods. Secondly, a systematic study of sludge analysis techniques was conducted, resulting in the development of a set of revised protocols. A preliminary method for the analysis of base/neutral and acid extractable compounds in sludge was selected which utilized homogenization/centrifugation extraction and gel permeation chromatography (GPC) cleanup. This scheme gave fairly good recoveries for the base/neutral and acidic compounds spiked into the sludge. Three alternative extraction procedures were evaluated for sludges in an attempt to develop a more efficient, selective and less time-consuming extraction method. The procedures evaluated include: continuous liquid-liquid extraction (CLLE), steam distillation and microextraction. None of the tested methods resulted in any significant improvements over the preliminary protocol. Several alternative GPC systems were evaluated for the revised protocol. The best overall performance was achieved with Bio-Beads SX-3 eluted with dichloromethane. Two adsorption chromatographic cleanup procedures using silica gel and Florisil were also developed. (See also W88-00406) (Geiger-PTT)
W88-00419

PROTOCOL FOR THE ANALYSIS OF A BROAD RANGE OF SPECIFIC ORGANIC COMPOUNDS IN DRINKING WATER,
Stanford Research Inst., Menlo Park, CA.
P. A. Boland, B. A. Kingsley, D. F. Stivers, and I. H. Pomerantz.
IN: Advances in the Identification & Analysis of

Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 831-838, 1 fig, 6 tab.

Descriptors: *Pollutant identification, *Drinking water, *Gas chromatography, *Mass spectrometry, *Organic compounds, Water analysis, Separation techniques, Chromatography, Aromatic compounds, Hydrocarbons.

An analytical protocol capable of application to raw and finished drinking water suitable for determining a large range of specific organic contaminants was developed. The protocol involves separation into fractions of purgeables, base/neutral extractables and acid extractables and analysis by gas chromatography. The purgeable fraction consists of two separate analyses - one for halocarbons and another for aromatic compounds. In both analyses the purgeable compounds are stripped from 25 milliliters of the sample using a flow of helium. The compounds are trapped on a room-temperature Tenax/charcoal trap and thermally desorbed onto a cool GC column which is then temperature-programmed to its upper limit. Halocarbons are detected by an electrolytic conductivity detector and the aromatics by a flame ionization detector. Identification and quantification are based on the addition of an internal standard to the water before it is purged. For compounds of a higher molecular weight, a liquid-liquid extraction procedure was selected using diethyl ether as the solvent and fractionating into base/neutral and acid fractions. GC analyses were performed on a glass capillary column that yields sharp, narrow chromatographic peaks that enhance sensitivity, separation and selectivity. GC/MS confirmation should be performed on all fractions, except perhaps the purgeable halocarbon fraction, where the overall confirmation rate was 86%. See also W88-00491) (Geiger-PTT)
W88-00420

COOPERATIVE QUALITY ASSURANCE PROGRAM FOR MONITORING CONTRACT LABORATORY PERFORMANCE,
Stanford Research Inst., Menlo Park, CA.
B. A. Kingsley, C. Gin, W. R. Peifer, D. F. Stivers, and S. H. Allen.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 839-859, 13 fig, 8 tab, 14 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Quality control, *Organic carbon, Mass spectrometry, Water analysis, Quantitative analysis, Chromatography, Gas chromatography.

A scheme was devised for a cooperative quality assurance program for monitoring contract laboratory performance. In conjunction with a U.S. Environmental Protection Agency survey of community water supplies, 1189 field samples were analyzed. Purgeable organics were analyzed using the purge-and-trap procedure developed by Bellar and Litchenburg and total organic carbon was analyzed by a Dohrmann DC-54 TOC analyzer with a modified sprayer. A five-part quality assurance protocol was used to monitor and evaluate data. Reference standards analyzed on a regular basis allowed monitoring of overall performance for a broad range of compounds and concentrations. Duplicate analyses permitted monitoring of the precision within the laboratory, often between instruments. Analysis of split and blind samples provided valuable interlaboratory checks of the accuracy of the analytical data. Most of the GC/MS confirmations provided a high degree of confidence in the identifications made. (See also W88-00406) (Geiger-PTT)
W88-00421

GLASS CAPILLARY GAS CHROMATOGRAPHIC/MASS SPECTROMETRIC ANALYSIS OF ORGANIC CONCENTRATES FROM DRINKING AND ADVANCED WASTE TREATMENT WATERS,
Battelle Columbus Labs., OH.
D. C. K. Lin, R. G. Melton, F. C. Kopfler, and S. V. Lucas.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 861-906, 1 fig, 6 tab, 11 ref.

Descriptors: *Organic compounds, *Pollutant identification, *Mass spectrometry, *Gas chromatography, *Drinking water, Wastewater analysis, Water analysis, Separation techniques, Chromatography, Reverse osmosis.

Concentrations of large quantities of drinking water and water from advanced waste treatment plants were analyzed for trace level organic compounds. Of the 16 concentrate reported here 15 were prepared using reverse osmosis (RO) technology and 1 was prepared using direct XAD-2 adsorption with diethyl ether elution. Organic acids and bases were extractable separately. Neutral components were partitioned on silica gel with four-step gradient elutions. The extracted bases were combined with one of the silica gel fractions, and the extracted acids were derivatized with diazomethane before analysis. Deuterated internal standards were added before GC/MS analysis. Information relevant to each identification was entered into a computerized database. In general, the compounds found in highest concentrations were fatty acids and related compounds, phthalates, and polyglycol compounds. Results also indicated that RO concentration may not be effective for the recovery of relatively small, nonpolar organic species. However, RO did not present the artifact generation problems encountered with the XAD-2 adsorption/solvent elution method. (See also W88-00406) (Geiger-PTT)
W88-00422

APPLICATION OF ORGANIC ANALYSIS FOR EVALUATION OF GRANULAR ACTIVATED CARBON PERFORMANCE IN DRINKING WATER TREATMENT,
Environmental Protection Agency, Cincinnati, OH.
J. DeMarco, A. A. Stevens, and D. J. Hartman.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 907-940, 14 fig, 4 tab, 24 ref.

Descriptors: *Pollutant identification, *Drinking water, *Activated carbon, *Performance evaluation, *Organic compounds, Water treatment, Mass spectrometry, Gas chromatography, Organic carbon, Hydrocarbons, Water analysis, Adsorption, Separation techniques.

Organic analysis was applied to test the performance of granular activated carbon (GAC) acting in two modes in the drinking water treatment process: as filter/adsorbers in sand replacement systems and as adsorbers or contactors only using sand filters prior to the adsorption process (post-filtration adsorption). Samples were analyzed for total organic carbon (TOC) using the Dohrmann TOC system. Three analyses were conducted for purgeable halogenated organics: instantaneous trihalomethanes (THM), simulated distribution THM, and THM formation potential. Response profiles from capillary column gas chromatographic analysis of influent and effluent samples from operating GAC beds were used to qualitatively judge adsorber performance. TOC results can serve as an operating guide at a given location if proper relationships can be established with TOC levels and concentrations of other substances. GAC reduced the simulated distribution THM concentrations and organic halogen levels, but the performance of the GAC system varied with changing influent conditions. Other drawbacks of the organic analysis of GAC performance include the requirement for subjective interpretation of some outputs and difficulties in managing large amounts of data. (See also W88-00406) (Geiger-PTT)
W88-00423

DETECTION, IDENTIFICATION AND QUANTITATIVE ANALYSIS OF DIHALOACETONITRILES IN CHLORINATED NATURAL WATERS,
West Palm Beach Water Dept., FL.
M. L. Trehy, and T. I. Bieber.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 941-975, 19 fig, 6 tab, 28 ref.

Descriptors: *Chlorination, *Organic compounds, *Pollutant identification, *Separation techniques, Chromatography, Water treatment, Water analysis.

The chlorination of natural water is responsible for the formation of trihalomethane (THM) and dihaloacetonitriles (DHAN). A liquid-liquid extraction (LLE) procedure has been used extensively for THM and DHAN analysis. The method is a modification of that developed by Henderson et al which used a squalane-coated Chromasorb in the column. The technique was applied to the analysis of THM and DHAN in spiked water samples and chlorinated natural waters. The LLE method avoids elevated temperature in the presence of water, thus minimizing hydrolysis. Since pentane extracts are injected, the chromatography occurs in the virtual absence of water. Use of a 10% squalane column does not degrade the DHAN. The dechlorinating agents sodium thiosulfate, sodium sulfite, and ferrocyanide reacted with the DHAN. Candidate precursors for DHAN are considered to be certain amino acids, polypeptides containing the corresponding amino acyl groups at the N-terminus, and humic and fulvic substances with amino acid moieties appended to the ring system. (See also W88-00406) (Geiger-PTT)
W88-00424

OXIDATIVE DEGRADATION OF AQUATIC HUMIC MATERIAL,
North Carolina Univ. at Chapel Hill. Dept. of Bacteriology.
R. F. Christman, W. T. Liao, D. S. Millington, and J. D. Johnson.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 979-999, 13 fig, 2 tab, 6 ref.

Descriptors: *Organic acids, *Pollutant identification, *Gas chromatography, *Mass spectrometry, *Chemical degradation, Water analysis, Organic compounds, Humic acid, Fulvic acid, Degradation, Oxidation.

Two isolation procedures were used to obtain humic substances from Black Lake, North Carolina. Lake water samples were filtered through a 10-micron filter and acidified to pH 2 with HCl to precipitate a combined humic-hymatomelanic acid fraction which was separated by settling and centrifugation. An alternate method involved filtering of samples and passing the acidified sample through a column of XAD-8 polyacrylic ester. The humic acid (HA) fraction was then separated from the solution as before. Amberlite XAD-8 was used in gel chromatography to help characterize the macromolecular properties of the ungraded humic materials. Both HA and fulvic acid (FA) obtained from the above isolation procedure were subjected to chemical degradation studies. Results were monitored by GC/MS analysis. The main compounds identified from the methylated products of an exhaustive permanganate oxidation of HA were straight (and some branched) chain fatty acid methyl esters, a series of aliphatic diesters with terminal carboxyl groups and a large number of one-ring aromatic esters. Comparison of the total ion chromatogram traces obtained from the excess permanganate oxidation of the new preparation of HA and FA showed a similar distribution of product types, between low-molecular-weight oxidation products, other aliphatics and aromatics, but there were notable differences in the relative proportions of certain individual components. (See also W88-00406) (Geiger-PTT)
W88-00425

LEVELS OF POLYCHLORINATED BIPHENYLS IN THE FORT EDWARD, NEW YORK, WATER SYSTEM,
Rensselaer Polytechnic Inst., Troy, NY.

M. Brinkman, K. Fogelman, J. Hoeflein, T. Lindh, and M. Pastel.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 1001-1015, 3 fig, 4 tab, 25 ref.

Descriptors: *Fate of pollutants, *Pollutant identification, *Polychlorinated biphenyls, *Bottom sediments, *Aquatic animals, Water pollution sources, Gas chromatography, Mass spectrometry, Sediments, Reservoirs, Macroinvertebrates, Bioaccumulation.

Samples of water, sediments, aquatic vertebrates, macroinvertebrates, and algae were collected from the Fort Edward water system and analyzed for levels of polychlorinated biphenyls (PCBs) by a gas chromatography/mass spectrometry technique. PCBs in rainfall at the reservoir were also measured. Only Aroclor 1016 and 1254 were detected in the samples. The total PCB level was relatively uniform throughout the reservoirs and the distribution system and PCB levels ranged from less than the detection limit of 12 nanograms/L to 160 nanograms/L. In the 30-day composite rain sample, the Aroclor 1016 level was 1300 nanograms/L. About two-thirds of the soil and sediment samples were contaminated with PCBs, but the level of contamination varied greatly according to sample site. In general, the biota exhibited much higher PCB levels than did the surrounding water or sediment. Most of this was in the form of Aroclor 1254. PCB levels were highest in the macroinvertebrates that inhabited the bottom sediments, which contained greater concentrations of PCBs than did water. (See also W88-00406) (Geiger-PTT)
W88-00426

INDUSTRIAL ORGANIC COMPOUNDS IN THE NIAGARA RIVER WATERSHED,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
B. L. Proctor, V. A. Elder, and R. A. Hites.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 1017-1036, 6 fig, 2 tab, 9 ref.

Descriptors: *Pollutant identification, *Fate of pollutants, *Water pollution sources, *Organic compounds, *Industrial wastes, Pesticides, Polychlorinated biphenyls, Sediments, Gas chromatography, Mass spectrometry, Water analysis, Rivers.

Water and sediment samples collected from the Niagara River were analyzed for industrial organic compounds by gas chromatography/mass spectrometry (GC/MS). Chlorinated benzenes and toluenes were found in almost all samples with the highest concentrations in the 102nd Street bay area. Mono-, di-, and trichlorobenzenes were found in water from Bloody Run Creek and Gill Creek. Traces of chlorinated benzenes were also detected in Niagara River water. Tetra-, penta-, and hexachlorobenzenes are probably by-products of trichlorobenzene production. BHC, dichlorophenol, and trichlorophenol were dumped in large amounts and were generally present in the sediment and water samples. Chloronaphthalenes, dodecanol and other alcohols, and dodecanethiol were detected in a heavily contaminated area of the 102nd Street bay. Mirex and another derivative of hexachlorocylopentadiene were found in sediment of Bloody Run Creek. Chloranthracenes or chlorophenathrenes were found in both 102nd Street bay and Bloody Run Creek sediments. Unusual cyclohexane derivatives were also detected in 102nd Street bay. PCBs and phenothiazine were found in Gill Creek. (See also W88-00406) (Geiger-PTT)
W88-00427

CHLORINATED ORGANICS OF LOW AND HIGH RELATIVE MOLECULAR MASS IN PULP MILL BLEACHERY EFFLUENTS,
K. Lindstrom, J. Nordin, and F. Osterberg.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 1039-1058, 10 fig, 2 tab, 23 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Chlorinated hydrocarbons, *Bleaching wastes, *Pulp and paper industry, Organic matter, Chloroform, Industrial wastes, Mass spectrometry, Separation techniques, Wastewater analysis, Gas chromatography.

This chapter reports on the characterization and determination of chlorinated organic matter of high and low relative molecular weight (mol wt) in spent bleach liquors (SBL) from a conventional bleaching process in relation to total organically bound chlorine (TOCl). The SBL were divided into four groups of chlorinated organics: high- mol wt (>1000), ether extractable (mol wt <1000), extremely volatile (mol wt <500), and water soluble (mol wt <1000). Chlorination-stage SBL exhibited the highest concentration of chlorinated organics of low relative molecular mass (mol wt <1000). Chlorinated organics of high relative mol wt (>1000) were mainly found in the extraction stage SBL. Pulp washing, chlorine concentration, and pH should be considered if the concentration of chlorinated organics of low relative mol wt are to be reduced. Of the TOCl in the fraction of low relative mol wt of the chlorination-stage SBL, 25% consisted of relatively lipophilic chlorinated compounds. The major extremely volatile chlorinated component was chloroform which was at its highest levels in the hypochlorite-stage SBL. (See also W88-00406) (Geiger-PTT)
W88-00428

NOVEL GAS CHROMATOGRAPHIC METHOD FOR THE ANALYSIS OF CHLORINATED PHENOLICS IN PULP MILL EFFLUENTS,
Pulp and Paper Research Inst. of Canada, Pointe Claire (Quebec).
R. H. Voxx, J. T. Wearing, and A. Wong.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 1059-1095, 19 fig, 9 tab, 31 ref.

Descriptors: *Bleaching wastes, *Gas chromatography, *Phenols, *Pulp wastes, *Pollutant identification, Industrial wastes, Chlorinated hydrocarbons, Pulp and paper industry, Organic compounds, Wastewater analysis, Separation techniques.

A novel method was developed for the determination of chlorinated phenolics in kraft pulp mill effluents and natural waters receiving such wastewaters. The method which involves capillary gas chromatography with electron capture detection eliminates the preisolation step by forming the acetate derivatives in situ after buffering of the water sample with potassium carbonate. This direct-acetylation approach provides a significant reduction of sample manipulation and hence a more rapid method for the routine determination of chlorinated phenolics in pulp mill effluents and receiving waters. To date, only the 3,4,5-trichloroveratrole species has been found by GC analysis. Most of the chlorinated phenolics identified in the present study of spent chlorination and alkali extraction liquors from the bleaching of hard- and softwood kraft pulp can be grouped into essentially six major classes: the chlorophenols, chloroguaiacols, chlorosyringols, chlorovanillins, chlorocatechols, and the chlorosyringealdehydes. In addition to the analysis of bleach plant effluents, the present method was applied to an investigation of the effects of pulp chlorination conditions on the formation of chlorinated phenolics in both chlorination and extraction-stage spent bleaching liquors, and analyses of combined mill effluents and receiving waters of kraft pulp mill effluents. (See also W88-00406) (Geiger-PTT)
W88-00429

OXIDIZED RESIN ACIDS IN DOUGLAS FIR WOOD EXTRACTIVES,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
I. H. Rogers, and H. W. Mahood.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 1097-1113, 4 fig, 1 tab, 13 ref.

Descriptors: *Pollutant identification, *Bioassays, *Aquatic insects, *Resins, *Pulp wastes, Separation techniques, Aquatic animals, Gas chromatography, Mass spectrometry, Toxicity, Organic compounds, Water pollution effects.

A study was conducted to separate and identify as many as possible of the oxidized resin acids in Douglas fir oleoresins which are prevalent in pulping wastes and to measure their toxicity to aquatic life. Air-dried Douglas fir woodchips were ground to a coarse wood-meal in a Wiley mill and were extracted with methanol for 24-hr in all-glass sohxlet apparatus. The extract was methylated with diazomethane and analyzed by gas chromatography/mass spectrometry (GC/MS) for the presence of oxidized resin acid methyl esters. Identified compounds in the resins included 7-keto-dehydroabietic acid (DHA), 7-keto-15-hydroxy-DHA methyl ester, and 7 hydroxy-DHA. These compounds were synthesized and used in static bioassays with Daphnia pulex. The toxicity of DHA was also tested in these bioassays. The oxidized resin acids, especially 7-hydroxy-DHA, had marked surface active properties in aqueous solutions. The oxidized forms displayed lower toxicities to Daphnia than DHA itself. (See also W88-00406) (Geiger-PTT)
W88-00430

HALOGENATED ORGANIC COMPOUNDS IN SPENT BLEACH LIQUORS: DETERMINATION, MUTAGENICITY TESTING AND BIOACCUMULATION,
Sentralinstitutt for Industriell Forskning, Oslo (Norway).
A. Bjorseth, G. E. Carlberg, N. Gjos, M. Moller, and G. Tveten.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 1115-1130, 3 fig, 6 tab, 31 ref.

Descriptors: *Water pollution effects, *Pollutant identification, *Mutagenicity, *Bleaching wastes, Chlorinated hydrocarbons, Toxicity, Bacteria, Fish, Effluents, Separation techniques, Industrial wastes, Pulp wastes, Wastewater analysis.

Effluents from chlorine bleacheries were separated by extraction into polar and nonpolar compounds. The nonpolar organics were extracted with cyclohexane, concentrated and analyzed by glass capillary gas chromatography. The polar constituents were silylated and analyzed by GC/MS. Mutagenicity testing of halogenated organics in spent bleach liquors was carried out in Salmonella typhimurium TA98 and TA100 and in cod, flounder, perch, roach, burbot, and freshwater herring and bream. Results of neutron activation analysis showed that sulfite plants discharge about equal amounts of nonpolar and polar chlorinated organic compounds, while sulfate plant effluents contain relatively less nonpolar and more polar constituents. In sulfite bleachery effluents, chlorinated cymene and calamenene and naphthalene are among the main constituents. In sulfate bleachery effluents chlorinated thiophene derivatives are among the main constituents. Bleachery effluents containing chlorinated compounds displayed mutagenicity which was reduced by metabolic activation and alkaline treatment. While the accumulated polar compounds clear fairly rapidly from fish, little is known about the metabolic kinetics and persistence of the accumulated nonpolar compounds. (See also W88-00406) (Geiger-PTT)
W88-00431

ANALYSIS OF TOXICITY AND BIODEGRADABILITY OF ORGANOCHLORINE COMPOUNDS RELEASED INTO THE ENVIRONMENT IN BLEACHING EFFLUENTS OF KRAFT PUMPING,

Helsinki Univ. (Finland). Dept. of General Microbiology.
M. Salkinoja-Salonen, M. L. Saxelin, J. Pere, T. Jaakkola, and J. Saarikoski.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 1131-1164, 14 fig, 7 tab, 32 ref.

Descriptors: *Pollutant identification, *Chlorinated hydrocarbons, *Water pollution effects, *Bleaching wastes, *Pulp wastes, Organic compounds, Biodegradation, Industrial wastes, Phenols, Toxicity, Fish, Aquatic insects, Water pollution sources.

The analysis of organochlorine compounds found in pulp bleaching wastes and their biodegradability in lakewater sediments and their toxicity to bacteria, daphnids and fish were examined in laboratory tests. Chlorophenols, guaiacols and catechols were extracted from spent bleach liquor and lakewater samples, ethylated in diazoethane and analyzed by gas-liquid chromatography. Spent liquors contained 2-8 grams of chlorinated organic compounds/cu m of wastewater. The toxicity of chlorinated phenols to fish and Daphnia increased with the degree of chlorination. The toxicity of bleaching effluents resides in the low molecular weight compounds. Chlorophenolic compounds of bleaching origin were found in lakewater and benthic sediment samples from up to several kilometers from the pulp mills. Chlorophenolic compounds in a Finnish lake ecosystem were found recalcitrant to degradation. Kraft bleaching effluents can be treated biologically to remove BOD, toxicity, chlorophenolic compounds and mutagenicity in a biological reactor consisting of an anaerobic fluidized bed reactor and an aerobic trickling filter. (See also W88-00406) (Geiger-PTT)
W88-00432

CONSENSUS VOLUNTARY REFERENCE COMPOUNDS FOR ORGANIC WATER POLLUTANTS,
American Chemical Society, Washington, DC.
L. H. Keith.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. p 1165-1170, 2 tab.

Descriptors: *Pollutant identification, *Data acquisition, *Hydrologic data collections, *Organic compounds, Sampling, Water analysis, Toxicity.

At the 1975 meeting of the Chemical Congress of the North American Continent, it was suggested that a council be organized to establish a consensus voluntary system that could be used easily as a basis for establishing references against which variations or improvements in analytical methodology for organic water pollutants could be compared. This objective was met by convening an international panel of environmental chemists who chose by consensus a list of model reference compounds. In 1979, panel members of the Pacific Conference in Honolulu nominated chemicals as consensus voluntary reference compounds (CVRC). Some chosen compounds are toxic, and some are known or suspected mutagens or carcinogens. The CVRC list should prove useful to environmental chemists in providing a reference for sampling, sample handling, and preparation before instrumental analysis. (See also W88-00406) (Geiger-PTT)
W88-00433

SURVEY OF PROCEDURES FOR DETERMINING VOLATILE ORGANICS IN WATER,
Monsanto Co., St. Louis, MO.
J. P. Mieure.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 3-16, 4 fig, 5 tab, 19 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, Headspace analysis, Chlorinated hydrocarbons, Volatility, Activated carbon, Adsorption, Purge and trap method, Liquid/liquid extraction, Distillation, Dialysis, Membrane processes.

Static headspace sampling is a convenient way to isolate and concentrate many volatile organics for gas chromatographic analysis. Detection limits range from sub- to mid-microgram/liter concentrations, depending on the compound and on the detector. Nonvolatile contaminants are excluded from the measuring system. Purge and trap sampling offers all the above advantages, plus 1-2 orders of magnitude more sensitivity. Foaming may be a problem with this technique. Solid sorbents have been shown to be effective collection media for selected compounds, but the general usage for concentrations below 50 micrograms/L needs to be verified. Liquid/liquid extraction is especially useful for compounds for which specific detectors are available. Round robin testing showed precision to be better than with the purge and trap technique. However, sample cleanup is minimal, so removal of interferences is unlikely. Distillation appears to be an effective way to concentrate water-soluble, volatile organics. These compounds are difficult to measure with the other techniques. Semipermeable membranes have not been widely used for isolation of volatile organics. However, rapid analyses are possible when used as an elective introduction device for a mass spectrometer. (See also W88-00434) (Author's abstract)
W88-00435

DEVELOPMENT OF A VOLATILE ORGANIC ANALYSIS TECHNIQUE FOR THE ORANGE-LOS ANGELES COUNTY REUSE STUDY,
Southern California Metropolitan Water District, Los Angeles.
S. W. Krasner, C. J. Hwang, R. S. Cohen, and M. J. McGuire.
IN: Chemistry in Water Reuse: Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. p 17-31, 4 fig, 5 tab, 19 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, Chlorinated hydrocarbons, Chromatography, Gas chromatography, Mass spectrometry, Aromatic compounds.

A volatile organic analysis technique has been developed and tested in several trace organic applications in the Orange-Los Angeles reuse study. After purging the volatile organics from the spiked sample, they are collected in a Tenax/Chromosorb 102 trap. A hot-air gun provides heat for desorption from the column. Desorbed organics enter the computerized gas chromatography/mass spectrometry system for characterization. The technique can detect 27 purgeable organic compounds with sensitivities on the order of subpart per billion. Compounds include vinyl chloride, methylene chloride, dichloroethanes, chloroform, carbon tetrachloride, benzene, trichloroethene, trichloroethane, toluene, tetrachloroethene, chlorobenzene, bromoform, dichlorobenzenes, and bromochloro compounds. (See also W88-00434) (Cassar-PTT)
W88-00436

TRACE ORGANIC SUBSTANCES IN THE RIVER LEE,
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5B.
W88-00438

MEASUREMENT OF TOTAL ORGANIC HALIDES (TOX) AND PURGEABLE ORGANIC HALIDES (POX) IN WATER USING CARBON ADSORPTION AND MICROCOULOMETRIC DETERMINATION,
Envirotech Corp., Santa Clara, CA. Dohrmann Div.
Y. Takahashi, R. T. Moore, and R. J. Joyce.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 127-146, 4 fig, 9 tab, 21 ref.

Descriptors: *Pollutant identification, *Chlorine compounds, *Bromine compounds, *Organic compounds, *Water analysis, Activated carbon, Adsorption, Halides, Organic carbon, Drinking water, Disinfection.

A method for determining TOX in water down to the 3-microgram C/L level using carbon adsorption/microcoulometric detection was developed. A method for determining POX in water at the same concentration levels using constant temperature purging and the microcoulometric detection was also developed. Carefully selected, coal-based granular activated carbon was satisfactory in terms of adsorption efficiency, halogenated background and inorganic halide rejection ratio. Application of these methods to raw and chlorinated drinking water showed that nonpurgeable POX concentrations are significantly higher than POX concentrations. Furthermore, most of the halogenated organics in these samples were reliably adsorbed on the granular activated carbon. Application also showed that disinfection with ClO2 and ozone produces very little TOX. (See also W88-00434) (Author's abstract)
W88-00441

HIGH-PERFORMANCE MACROPOROUS RESIN CONCENTRATION SYSTEM FOR TRACE ORGANIC RESIDUES IN WATER,
Los Angeles County Sanitation Districts, Whittier, CA.
R. B. Baird, C. A. Jacks, R. L. Jenkins, J. P. Gute, and L. Neiess.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 149-169, 6 fig, 7 tab, 32 ref.

Descriptors: *Pollutant identification, *Water analysis, *Mutagens, *Resins, *Organic compounds, Trace levels, Chromatography, Bioassay, Wastewater analysis, Adsorption, Reclaimed water, Pesticides, Chlorinated hydrocarbons, Carcinogens, Organic carbon.

A high-performance, high-volume trace organics concentration system was developed which yields a sufficient mass of residue for performance of a battery of bioassay and chemical characterizations. Using a series of different ionic and nonionic macroporous resins as microparticulate column packings, organic carbon removals from reclaimed waters up to 90% were demonstrated. Evaluations indicated that this system, functioning as a representative mixture of the mutagenic materials present in reclaimed drinking waters. The yield of the system provides a relative sensitivity in the mutagen assay of 30 and 160 revertants/L for tester strains TA98 and TA100, respectively. The system is also capable of yielding satisfactory quantitative data for selected target organic compounds, providing that suitable internal system standards are employed for each sample. (See also W88-00434) (Author's abstract)
W88-00442

RECOVERY OF MUTAGENS FROM WATER BY THE PARFAIT/DISTILLATION METHOD,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
J. B. Johnston, and M. K. Verdeyen.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 171-190, 4 fig, 7 tab, 27 ref. Contract Nos. 5-057-111 and 3973A, 2-6.

Descriptors: *Pollutant identification, *Mutagens, *Water analysis, Parfait column, Adsorption, Ion exchange resins, Distillation, Benzo(a)pyrene, Ethidium bromide, Nitroquinoline oxide, Sodium azide, Bioassay.

The parfait column was tested as a method for recovering mutagens, especially the poorly volatile and highly water-soluble compounds. The column was made with a series of ion exchange resin beds, layered in a single column and separated with washers. Two sets of experiments were run: (1) recovery of mutagens added to laboratory deionized water and (2) recovery of mutagens from environmental surface waters both nonspiked and spiked with mutagens. The samples passed through a cation exchange resin, then an anion exchange resin to remove metal ions, then through a silica gel to remove debris and adsorb highly water-insoluble organic compounds. Effluent from the column and the individual fractions collected on the resins and adsorbent were vacuum distilled.

The resulting fractions were bioassayed using the Ames test. Recoveries varied considerably. Highest recoveries were obtained using benzo(a)pyrene (about 70%). Other added mutagens were recovered to a lesser degree: ethidium bromide (22% and 37%), 4-nitroquinoline-1-oxide (zero and 52%), 2-(2-furyl)-3-(5-nitro-2-furyl) acrylamide (2.8% to 9.9%), and sodium azide (none detected). (See also W88-00434) (Cassar-PTT)
W88-00443

CONCENTRATION OF ORGANICS FOR TOXICITY TESTING USING MEMBRANE PROCESSES,
J. K. Smith, S. C. Lynch, and F. C. Kopfler.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 191-203, 5 fig, 8 tab, 12 ref.

Descriptors: *Pollutant identification, *Membrane processes, *Water analysis, *Toxicity, *Organic compounds, Reverse osmosis, Donnan dialysis, Dialysis.

Two membrane processes, reverse osmosis and Donnan dialysis, have been developed for field processing of water to obtain enriched organic contaminant samples for in vitro and long-term in vivo toxicological studies. A review of theory of the processes demonstrates that a representative sample can be obtained at good recovery levels. Selection of membranes and materials of construction are critical to maximizing recovery. The two key factors in selection of materials are adsorption of organics and membrane rejection. Proper selection and sizing of the reverse osmosis and Donnan unit operation allows the concentration to proceed to 100-1000X while controlling the inorganic ion concentration below precipitation levels. More than 30 field concentrations have been performed providing samples for analytical and toxicological studies. (See also W88-00434) (Author's abstract)
W88-00444

APPLICATION OF THERMAL DESORPTION-GAS CHROMATOGRAPHY/MASS SPECTROMETRY TO MONITOR DYNAMIC ADSORPTION IN ACTIVATED CARBON,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
K. Alben, and E. Shpirt.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 269-284, 9 fig, 1 tab, 19 ref.

Descriptors: *Pollutant identification, *Water treatment, *Activated carbon, *Adsorption, *Organic compounds, Water analysis, Wastewater analysis, Monitoring, Thermal desorption, Chromatography, Gas chromatography, Mass spectrometry.

Analysis of granular activated carbon by thermal desorption-gas chromatography/mass spectrometry produced two types of data useful for monitoring activated carbon systems. (1) Base peak mass spectrometry profiles improved the specificity of sample fingerprints compared to the flame ionization detector. Samples from a wastewater treatment plant contained a wide variety of volatile synthetic organic compounds. It is likely that base peak profiles could be obtained for these compounds by thermal desorption gas chromatography/mass spectrometry of activated carbon from a municipal treatment plant. (2) Mass transfer profiles revealed the occurrence of dynamic adsorption processes, including saturation, competition, and displacement. Analysis of samples from a water treatment plant showed that sections of the activated carbon system were generally saturated with chloroform. Less volatile organics accumulated at the inlet of the activated carbon system, indicating that they had not achieved saturation. The data suggested that the less volatile compounds had displaced chloroform (or substances that thermally decompose to form chloroform) from the activated carbon. Similar information can be obtained by analyzing water samples taken from representative points throughout the activated carbon system. (See also W88-00434) (Cassar-PTT)
W88-00447

CHARACTERIZATION OF UNCLASSIFIED NONFERMENTATIVE GRAM NEGATIVE BACTERIA IN DRINKING WATER,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
D. F. Spino.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152165. Price codes: A03 in paper copy, A01 in microfiche. EPA-600/D-83-003, 1983. 25 p, 2 fig, 13 tab, 15 ref.

Descriptors: *Bacteria, *Water analysis, Water pollution, Drinking water, Public health aspects, Toxicity, Potable water.

The group of bacteria most frequently found in water distribution systems consists of nonfermentative gram negative rods. Only a small percentage of these bacteria are identifiable using commercially prepared kits or other identification keys because many isolates fail to grow in conventional media used for biochemical characterization. In this study, modified base media were developed and used with specific substrates to detect enzymatic activity. The use of the modified base media combined with a lower incubation temperature allowed expression of increased enzymatic activity by many of the organisms. Although this permitted the characterization of the majority of these organisms, exact identification was unsuccessful since these organisms do not fit descriptions of known species found in current taxonomic schema. (Author's abstract)
W88-00480

WATER QUALITY OF CISTERN WATER IN ST. THOMAS, U.S.V.I., A PRELIMINARY SURVEY; B. MICROBIAL ANALYSIS AND MAJOR ION COMPOSITION,
Caribbean Research Inst., St. Thomas, VI.
F. Rinehart, P. Hoffman, M. J. Canoy, and A. Knudsen.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205753/AS. Price codes: A04 in paper copy, A01 in microfiche. Technical Report No. 15, Sept. 1983. 51 p, 2 fig, 6 tab, 15 ref. Project No. OWRT A-010-VI(1).

Descriptors: *Cistern water, *Virgin Islands, Microbial water standards, Water quality, Drinking water standards, Salmonella, Streptococcus, Coliforms, St. Thomas.

Studies were conducted in two phases to investigate the scope and nature of ionic and microbial contamination of domestic cisterns in the U.S.V.I. The majority of 130 cisterns did not meet minimum U.S. microbial drinking water standards. Over 90%, whether or not they met coliform standards, were heavily contaminated. Common, potentially pathogenic, bacteria were Streptococcus faecalis, Klebshiella spp., Proteus spp, Shigella spp., and Salmonella spp. The water was examined for total dissolved solids and 10 metals. In all cases the water met the minimum standards for dissolved solids and heavy metals. (Canoy-Caribbean Res. Inst.)
W88-00536

NIWR INTERLABORATORY COMPARISON STUDY NO. 80/C: DETERMINATION OF TRACE METALS IN SEWAGE SLUDGE, EVALUATION OF RESULTS,
National Inst. for Water Research, Pretoria (South Africa).
R. Smith.
Research Report No. 395, 1981. 33 p, 9 fig, 5 tab, 21 ref, 3 append.

Descriptors: *South Africa, *Sewage sludge, *Sludge analysis, *Trace elements, Aluminum, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Nickel, Zinc, Atomic absorption spectrophotometry, Heavy metals, Trace metals.

This study forms part of the NIWR's series of interlaboratory comparison studies involving southern African laboratories engaged in water and wastewater analysis, and is concerned with the analysis by 20 laboratories of two samples of dried sewage sludge for aluminum, cadmium, chromium, copper, iron, lead, manganese, nickel, and zinc. The results obtained are evaluated and discussed, along with some of the advantages and disadvantages of various sample pretreatment techniques. The mean values of the results obtained using the U.S. EPA's recommended sample pretreatment procedure were found to be in good agreement with those obtained using a wide variety of other sample pretreatment techniques, with the exception of those for aluminum. More drastic pretreatment, in the form of fusion or a more vigorous digestion procedure, is advisable for complete extraction of this metal. Most of the laboratories employed flame atomic absorption spectrophotometry for the analysis. The use of suitable interference suppressants and, in certain cases, background correction, was recommended with this method. (Author's abstract)
W88-00622

CHEMICAL ANALYSIS SUPPORT: LIMITED ANALYSIS OF BRISTOL, RHODE ISLAND WELL WATER SAMPLES,
Little (Arthur D.), Inc., Cambridge, MA.
K. Beltis, C. Jones, and L. Sadowski.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-120836. Price codes: A04 in paper copy, A01 in microfiche. Report DRXTH-TE-CR-2135, September 1982. Final Task Report. 63 p, 1 tab, 3 ref, 3 append.

Descriptors: *Chemical analysis, *Well water, *Groundwater pollution, Bristol, Rhode Island, Priority pollutants, Pesticides, 1,1-Dimethylhydrazine.

In order to assess possible contamination of well water in Bristol, Rhode Island, field samples were collected and analyzed for volatile, acid, base-neutral and pesticide priority pollutants. In addition, experiments were conducted to develop and analytical method for 1,1-dimethylhydrazine. Samples for the volatile organic analysis were analyzed directly by the purge and trap method. Acid and base-neutral analyses were conducted after extraction with methylene chloride. Analyses of samples for pesticide priority pollutants were conducted following extraction with 15% methylene chloride in hexane. None of these pollutants were detected above the detection limits determined from quality control samples. Furthermore, no satisfactory method was found for the detection of 1,1-dimethylhydrazine. (Halterman-PTT)
W88-00652

NIWR INTERLABORATORY COMPARISON STUDY NO. 80/B: DETERMINATION OF TRACE METALS; EVALUATION OF RESULTS,
National Inst. for Water Research, Pretoria (South Africa).
R. Smith.
CSIR Research Report No. 394, 1981. 26 p, 10 fig, 6 tab, 14 ref, 2 append.

Descriptors: *Chemical analysis, *Metals, *Trace metals, *Trace elements, *Heavy metal determination, *Water analysis, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Zinc, Arsenic, Selenium, Mercury, Atomic adsorption spectrophotometry.

In order to determine and compare their accuracy of analytical capabilities, 28 southern African wastewater analysis laboratories were supplied, for analysis, water samples with known concentrations of various trace metals, including cadmium, lead, chromium, manganese, copper, zinc, iron, arsenic, selenium and mercury. Twenty-seven laboratories analyzed the samples using atomic spectrophotometry methods and one laboratory used inductively-coupled plasma optical emission spectroscopy (ICP). The most reliable methods of analyses for cadmium, chromium, copper, iron, lead, manganese, and zinc were obtained by concentrating samples prior to determination by direct flame adsorption. The excellent results obtained by ICP indicate the value of this new, but as yet relatively expensive, technique for trace element determination. A fairly wide spread of values was obtained for arsenic and selenium. The use of sodium boro-

hydride as the hydride generant for arsenic and selenium analysis is recommended over the use of a zinc slurry. All labs carrying out mercury determination used the cold vapor technique, which is recommended for the determination of low levels (0.2 micrograms/1 detection limit) of mercury. Chelation/solvent extraction techniques generally produced the largest level of error. (Halterman-PTT)
W88-00664

FREQUENCY ANALYSIS OF PESTICIDE CONCENTRATIONS FOR RISK ASSESSMENT (FRANCO MODEL),
Battelle Pacific Northwest Labs., Richland, WA.
A. R. Olsen, and S. E. Wise.
Report EPA-600/3-82-044, August 1982. Environmental Research Laboratory, Athens, GA. 116 p, 5 fig, 4 tab, 2 ref, 3 append. Contract No. 68-03-2613.

Descriptors: *Computer programs, *Surface waters, *Pesticides, Agricultural runoff, Computer models, Risks.

A method was developed for the statistical characterization of the occurrence and duration of pesticide concentrations in surface waters receiving runoff from agricultural lands. The characterization bridges the gap between simulated instream pesticide modeling and the risk assessment information available from laboratory studies on aquatic biota. A computer program FRANCO completes the frequency analysis of concentration characterization. The documentation is part of the Chemical Migration and Risk Assessment Methodology. A case study of the Four Mile Creek Watershed is used to illustrate the application of the Franco program. FRANCO's input procedure requires the user to select the concentrations and durations to be used for summarization very judiciously. Appendices contain the FRANCO User's Guide, FRANCO program Module descriptions, and FRANCO Source listing. (Cutty-PTT)
W88-00677

WATER ANALYSIS, VOLUME II: INORGANIC SPECIES, PART 2.
Academic Press, Inc., Orlando, FL. 1984. 405 p. Edited by Roger A. Minear and Lawrence H. Keith.

Descriptors: *Pollutant identification, *Water analysis, *Inorganic compounds, *Spectrometry, Electrodes.

The theoretical and practical aspects of determining inorganic species in water are described in depth. Molecular absorption spectroscopy has been largely replaced by other methods except for determination of phosphorus and nitrogen. Atomic absorption is widely used for metals analysis. Flameless atomization and hydride volatilization techniques have further reduced detection limits. Inductively coupled plasma emission is featured in the discussion on atomic emission methods. Molecular luminescence (fluorescence, phosphorescence, and chemiluminescence), more commonly used in organic analyses, have some special applications in inorganic analysis, in particular, phosphate and chromium (3+). Spark-source mass spectrometry has proved useful in oxygen isotope studies and other applications. Three electrochemical methods are discussed: ion-selective electrodes, amperometric analysis, and anodic stripping. (See W88-00686 thru W88-00693) (Cassar-PTT)
W88-00685

MOLECULAR ABSORPTION SPECTROPHOTOMETRY,
Geological Survey, Doraville, GA. Water Resources Div.
B. E. Jones, D. E. Erdmann, and M. W. Skougstad.
IN: Water Analysis, Volume II: Inorganic Species, Part 2, 1984. p 1-60, 30 fig, 1 tab, 72 ref.

Descriptors: *Pollutant identification, *Water analysis, *Spectrophotometry, Colorimetry, Beer's law, Inorganic compounds.

Molecular absorption spectrophotometry (colorimetry) is a long-established method for determining inorganic substances in water. It depends on the ability of dissolved species to absorb radiant energy at a specific wavelength in the visible or ultraviolet regions of the spectrum. For most species of concern in water analysis, the analyte must be reacted with a color-forming reagent. Basic principles of spectrophotometry are discussed. Radiant energy sources can be tungsten lamps, deuterium discharge lamps, and infrared sources. Wavelength selectors may be filters (absorption or interference), prism monochromators, and grating monochromators. Several different types of detectors may be used. In order of ascending cost these are the photovoltaic (barrier-layer) cell, the phototube, and multiplying phototube (photomultiplier). More recent developments are the photodiode and the television camera type. Judging the utility of a detector depends on the efficiency of response, the noise level of the output signal, and the linearity of output-to-input ratio. The D'Arsonval meter or a pen-and-paper recorder are suitable recording devices. The instrument components described previously are combined to produce systems of several types: colorimeter, single-beam, double-beam, and photodiode-array. Spectrophotometers have also been adapted to automation and field testing. Other subjects included are Beer's law, precision, methods of quantitation, requirements for chemical systems, and methods for determination of ammonia, boron, bromide, chloride, chlorine cyanide, iodide, nitrate, nitrite, COD, phosphorus, silica, sulfate, iron, and vanadium. (See also W88-00685) (Cassar-PTT)
W88-00686

ATOMIC ABSORPTION SPECTROMETRY,
National Bureau of Standards (NML), Washington, DC. Center for Analytical Chemistry.
T. C. Rains.
IN: Water Analysis, Volume II: Inorganic Species, Part 2, 1984. p 61-110, 5 fig, 8 tab, 248 ref.

Descriptors: *Pollutant identification, *Water analysis, *Spectroscopy, Atomic absorption spectroscopy, Metals, Mercury, Sample preparation, Trace elements, Inorganic compounds.

The basic components of atomic absorption spectrometers are primary light source, vaporizing system, monochromator, electronics and readout, and computer. A table lists the limits of detection for many elements. Interferences can be classified as spectral, physical, chemical, interelement, and ionization. Methods have been developed to minimize these interferences. Among the preconcentration and separation techniques necessary at the low levels of analyte encountered in water analysis are evaporation, chelation-solvent extraction, ion exchange, and coprecipitation. Atomic absorption is widely used to detect mercury at very low levels by the mercury cold-vapor method. Certain methods (Sb, As, Bi, Sn, Se, Te, and Pb) can be detected by hydride generation. Methods for the following groups are briefly discussed: (1) alkaline metals, (2) alkaline earth metals, (3) copper, gold, silver, zinc, cadmium, (4) mercury, (5) boron, aluminum, gallium, indium, thallium, (6) titanium, zirconium, silicon, germanium, (7) vanadium, chromium, manganese, molybdenum, tungsten, (8) tin, lead, antimony, bismuth, (9) arsenic, selenium, tellurium, and (10) iron, cobalt, nickel. A table on atomic absorption spectrometric analysis of water lists 36 elements with the appropriate atomizer, the matrix (sea water, natural water, etc.), and reference. (See also W88-00685) (Cassar-PTT)
W88-00687

ATOMIC EMISSION METHODS,
Ames Lab., IA.
R. K. Winge, and V. A. Fassel.
IN: Water Analysis, Volume II: Inorganic Species, Part 2, 1984. p 111-153, 8 fig, 10 tab, 127 ref.

Descriptors: *Pollutant identification, *Water analysis, *Spectrometry, *Atomic emission spectrometry, Metals, Trace metals, Sample preparation, X-ray spectrometry, Inorganic compounds.

The use of arc, spark, and flame excitation sources has a long history in spectroscopic analysis. Later improvements featured inclusion of the spark in spray, porous graphite cup, vacuum graphite cup, rotating disk, de-stabilized arc, and variations of these. Plasma excitation sources make possible even lower detection limits. Plasma arcs and microwave and high-frequency plasmas are sources of this type. However, inductively coupled plasma (ICP) systems have proved very valuable for analyzing water samples. A basic ICP-atomic emission spectrometry system consists of a high-frequency excitation source, a torch and sample nebulization assembly, a spectrometer, and a data acquisition system. The dominant variables are gas flow rate, generator power, nebulization and sample aerosol transport, and the observation zone. Interferences, detection limits, and applications of the ICP system are discussed. X-ray can also be an emission source. Two variations of this are X-ray fluorescence spectrometry and particle-induced X-ray emission. Sample concentration methods are summarized. (See also W88-00685) (Cassar-PTT)
W88-00688

MOLECULAR LUMINESCENCE METHODS,
Tennessee Univ., Knoxville. Dept. of Chemistry.
E. L. Wehry.
IN: Water Analysis, Volume II: Inorganic Species, Part 2, 1984. p 155-224, 9 fig, 4 tab, 225 ref.

Descriptors: *Pollutant identification, *Water analysis, *Luminescence, Fluorescence, Photoluminescence, Chemiluminescence, Phosphates, Chromium, Metals, Trace metals, Inorganic compounds.

The fundamental characteristics of molecular luminescence methods for water analysis are described. Types of luminescence include chemiluminescence, photoluminescence, fluorescence, phosphorescence, electrotuminescence, thermoluminescence, and triboluminescence. Concentrating on chemiluminescence and photoluminescence, the following subjects are discussed: basic theory, quantitative basis, instrumentation and experimental procedures, applications to determination of inorganic species, including phosphate and chromium (3+). (See also W88-00685) (Cassar-PTT)
W88-00689

MASS SPECTROMETRY,
Denver Research Inst., CO.
J. Wallace, and R. Brown.
IN: Water Analysis, Volume II: Inorganic Species, Part 2, 1984. p 225-247, 5 fig, 30 ref.

Descriptors: *Pollutant identification, *Water analysis, *Mass spectrometry, *Spectrometry, Isotope studies.

Spark-source mass spectrometry uses Mattauch-Hertzog geometry. This involves the relative locations and shapes of the ion source, the electrostatic analyzer, and the magnetic analyzer. The most widely used ion detector is the Schumann-type photographic plate with silver bromide crystals on the surface of the gelatin emulsion. Electrical detection systems can operate in the scanning (produces entire spectrum) or peak-switching mode (examines predetermined peaks at greater precision). The most intense components of a spark-source mass spectrum are singly charged, monatomic ions of the major component, followed by doubly charged, monatomic ions of the major component and singly charged polymers. Interferences are less of a problem than in many other analytical methods. Interference can result from multiply charged ions, polymeric molecular ions, organic molecules, and to a minor degree, charge-exchange processes and background continua and halos. The spark-source mass spectrometer can detect all stable isotopes in the periodic table. However, C, H, N, O, and the noble gases are not detected with satisfactory accuracy. Samples for analysis are formed into rigid, nonvolatile, conducting electrodes by deposition into a conducting powder, deposition onto pure metal or semiconductor, electrolysis, or bomb combustion. Mass spectrometry has found many uses in studying the hydrologic cycle, pollutants, acid rain, and paleotemperatures. (See also W88-00685) (Cassar-PTT)
W88-00690

ELECTROCHEMICAL METHODS: ION-SELECTIVE ELECTRODES,
North Carolina Univ. at Chapel Hill. Dept. of Chemistry.
R. P. Buck.
IN: Water Analysis, Volume II: Inorganic Species, Part 2, 1984. p 249-321, 26 fig, 20 tab, 94 ref.

Descriptors: *Pollutant identification, *Water analysis, *Electrodes, Ion selective electrodes, Inorganic compounds, Electrochemistry.

Ion selective electrodes measure the activities of species in aqueous and mixed solvents or partial pressures of dissolved gases in water. They are membrane-based and involve permselective ion-conducting materials. The types of ion selective electrodes are (1) crystalline, primary, homogeneous, (2) crystalline, primary, heterogeneous, (3) noncrystalline, primary, heterogeneous and homogeneous, (4) sensitized, and (5) reference and combination. Descriptions, response equations for the steady state, and response parameters are given for each type of electrode. Also discussed are junction and diffusion potentials, activity and ionic strength, junction structure and problems, sensitivity coefficients and interferences, detection limits, time responses, and error sources. (See also W88-00685) (Cassar-PTT)
W88-00691

ELECTROCHEMICAL METHODS: AMPEROMETRIC ANALYSIS,
North Carolina Univ. at Chapel Hill. School of Public Health.
J. D. Johnson.
IN: Water Analysis, Volume II: Inorganic Species, Part 2, 1984. p 323-344, 6 fig, 27 ref.

Descriptors: *Pollutant identification, *Water analysis, *Amperometry, *Electrodes, Titration, Oxidation, Chlorine, Ozone, Oxygen, Inorganic compounds.

Amperometric methods are basically of two kinds, end-point detection and direct measurement. Amperometric titrations of oxidants are end-point methods that can be made with great sensitivity and accuracy using relatively simple equipment. Although they are subject to interferences from electrode fouling and poisoning agents such as surfactants and silver, these tend to be less serious than in direct-measurement cells. The amperometric titration method for free chlorine, for instance, is not subject to chloramine or Mn(4+) interferences, because these compounds are not reduced by the arsenite or phenylarsine oxide titrant. Both one- and two-polarized-electrode amperometry can be understood in terms of the individual oxidation and reduction processes occurring as a function of electrode potential. The two-electrode system is slightly more sensitive in clean systems like iodometric titrations but suffers slightly more from electrode fouling. Bare-electrode amperometric cells are simple and useful for continuous monitors. These systems suffer most from electrode fouling and interferences. They are not selective for free chlorine in the presence of chloramine in contrast to amperometric titration. The iodometric methods suffer less from electrode-fouling problems but are the most sensitive to chemical interferences. Membrane-covered electrodes must be regularly calibrated but are more selective and less sensitive to interferences. Pulse amperometric membrane electrodes appear to offer good sensitivity and low temperature dependence. (See also W88-00685) (Author's abstract)
W88-00692

ELECTROCHEMICAL METHODS: ANODIC STRIPPING,
North Carolina Univ. at Chapel Hill. School of Public Health.
M. S. Shuman, and M. Martin-Goldberg.
IN: Water Analysis, Volume II: Inorganic Species, Part 2, 1984. p 345-388, 10 fig, 1 tab, 144 ref.

Descriptors: *Pollutant identification, *Water analysis, *Voltammetry, Anodic stripping, Inorganic compounds, Electrochemistry, Wastewater analysis, Sample preparation, Metals.

Stripping voltammetry is a versatile technique for water and wastewater analysis. Both metals and nonmetals are analyzed at extreme dilution. Metals are determined by forming and oxidizing metal amalgams and nonmetals by deposition of films and stripping by reduction. The technique is applied to studies of trace-metal speciation, the measurement of complexation capacity, and estimation of stability constants and kinetic rate constants of metal complexes. Multielement analysis is possible when the amalgam or deposit of each element is stripped at a separate potential. Metal complexation is studied by selecting reduction or by observation of peak potentials or pseudopolarogram half-wave potentials. Concentrations of nonlabile complexes are determined by a complexiometric titration and the end point is related to the solution complexation capacity. Complex stability constants are estimated from potential shift and kinetic rates are available from rotating-disk experiments. There are many variants of the basic technique useful for minimizing interferences and increasing sensitivity. Interferences from intermetallic-compound formation or from organic materials are minimized by solution modification, charging currents by stripping with collection or differential pulse stripping, and ohmic loss by cell rearrangement or positive feedback. Automation and continuous analysis are accomplished using tubular electrodes and computer interfacing. Anodic stripping should enjoy greater popularity in water analysis. It is extremely sensitive, possesses good precision and is carried out with relatively simple and inexpensive commercial instrumentation. (See also W88-00685) (Author's abstract)
W88-00693

CHEMICAL SEPARATION OF WATER SAMPLES,
Howard Univ., Washington, DC.
M. M. Varma, B. E. Adebona, D. M. Patel, and B. Fisher.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-202438/AS. Price codes: A05 in paper copy, A01 in microfiche. District of Columbia Water Resources Research Center, Washington, July 1985. 75 p, 6 fig, 39 ref, 3 app. Contract No. 14-08-0001-G898. Project No. USGS G898-02.

Descriptors: *Wastewater analysis, *Fractionation, *Water analysis, *Pollutant identification, Liquid-liquid extraction, Microanalysis, Organics, Chromatography, Gas chromatography, Mass spectrometry, Separation techniques.

For the determination of the presence of microquantities of organics in water and wastewater samples, concentration and extraction was done by batch extraction, continuous liquid-liquid extraction and lyophilization. The results indicated that batch extraction procedure provided better results than continuous liquid-liquid extraction procedure, which needs further polishing. One wastewater sample showed the presence of 4-nonylphenol - a metabolite of nonionic surfactants. (Varma-Howard U.)
W88-00739

HYDROSPHERIC TRACE ELEMENTS AND THEIR APPLICATION IN TRACING WATER POLLUTANTS,
Oregon State Univ., Corvallis. Dept. of Chemistry.
W. D. Loveland.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-202180/AS. Price codes: A03 in paper copy, A01 in microfiche. Oregon Water Resources Research Institute, Corvallis. Final Technical Completion report, June 1983. 24 p, 13 app. Contract No. 14-34-0001-8110. Project No. B-055-ORE (1).

Descriptors: *Radioactive tracers, *Fate of pollutants, *Rare earth elements, Tracers, X-ray fluorescence, Radioactivity techniques, Monitoring, Water pollution sources, Organic compounds, Trace elements, Fluorescence, Pollutant identification, Path of pollutants.

Stable activable tracer technologies using rare earth nuclides with short-lived activation products were developed and tested in both laboratory and field. These tracers have been applied to the monitoring of pollutant dispersal in fresh water and estuarine systems and to trace toxic organic chemicals in the marine environment. The development, testing and application of stable x-ray fluorescent tracers for small water systems is also described. These non-toxic, cost-competitive tracers are sensitive, and not adsorbed by sediments, and can mark specific pollutants making it possible to trace the effluent from several source simultaneously. The naturally occurring levels of the tracer metal atoms, particularly the levels of earth elements, were found to be quite low in Pacific Northwest streams and lakes. The rare earth elemental concentrations in river water are controlled by the solubilities of rare earth phosphates and by the association of rare earth elements with humic substances. (Geiger-PTT)
W88-00740

OPERATING PROCEDURES AND QUALITY CONTROL ASSURANCE PROGRAM FOR WATER QUALITY MONITORING NETWORK.
Ohio River Valley Water Sanitation Commission, Cincinnati.
June 1984. 89 p, 5 fig, 7 tab, 4 append.

Descriptors: *Pollutant identification, *Sampling, *Water quality control, *Water analysis, *Ohio River, Organic compounds, Sample preservation, Chemical analysis, Data processing, Rivers, Sample preparation, Water sampling, Metals, Measuring instruments, Monitoring, Network design.

The quality control assurance procedures for the Ohio River Valley Water Sanitation Commission (ORSANCO) river monitoring program conforms with those published in the Federal Register. The elements of the program are representative sampling, sampling devices and preservation of samples, shipment of samples, chain of custody, analytical procedures, quality control of data, and data reporting. Detailed procedures are given for all aspects of sampling and analysis as they apply to the program. Included are detailed instructions for maintenance and service of electronic quality monitors and for analysis of organic compounds. (Cassar-PTT)
W88-00797

GREAT LAKES WATER QUALITY BOARD, REPORT TO THE INTERNATIONAL JOINT COMMISSION, 1985 REPORT ON GREAT LAKES WATER QUALITY.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Regional Office.
For primary bibliographic entry see Field 5B.
W88-00821

SOUTH AFRICAN MARINE POLLUTION MONITORING PROGRAMME: 1979-1982.
National Programme for Environmental Sciences, Pretoria (South Africa). Committee for Marine Pollution.
For primary bibliographic entry see Field 5B.
W88-00824

NIWR INTERLABORATORY COMPARISON STUDY NO. 81/B: DETERMINATION OF PHYSICAL PROPERTIES, EVALUATION OF RESULTS,
National Inst. for Water Research, Pretoria (South Africa).
R. Smith.
Research Report No. 571, 1982. 25 p, 5 fig, 7 tab, 15 ref, 2 append.

Descriptors: *Pollutant identification, *Water analysis, Laboratories, Color, Turbidity, Hydrogen ion concentration, Electrical conductivity, Conductivity, Physical properties.

An interlaboratory comparison involving 42 South African water quality laboratories indicated that electrical conductivity and total residue results

showed good accuracy and precision. pH results, however, were widespread. Standard deviation on a buffered sample was 0.4 pH units; the coefficient of variation was 8.5%. Color determination at low levels (10 units) showed a standard deviation of 7 units and a coefficient of variation of 52.2%. Turbidity measurements, mostly by the nephelometric method, showed good accuracy and precision at the upper level (50 NTU) and poor results at the lower level (6 NTU). (Cassar-PTT)
W88-00836

UTILITY OF THE SCOPE FOR GROWTH INDEX TO ASSESS THE PHYSIOLOGICAL IMPACT OF BLACK ROCK HARBOR SUSPENDED SEDIMENT ON THE BLUE MUSSEL, MYTILUS EDULIS: A LABORATORY EVALUATION,
Environmental Research Lab., Narragansett, RI.
W. G. Nelson, D. Black, and D. Phelps.
Technical Report D-85-6, September 1985. Final Report. 56 p, 4 fig, 9 tab, 31 ref, append.

Descriptors: *Dredging, *Ocean dumping, Marine biology, Marine environment, Environment, Aquatic animals, Pollutants, Benthic fauna, Mussels, Mollusks.

The sensitivity, variability, and reproducibility of the scope for growth index (SFG) as an indicator of physiological condition was evaluated utilizing the blue mussel, Mytilus edulis, after exposure to highly contaminated dredged material. A preliminary experiment was completed to determine a no-observable-effects-concentration due to suspended reference sediment (REF) alone (50 mg/L). The effect of contaminated dredged material from Black Rock Harbor (BRH) was then tested using three treatments of suspended sediment: (a) 50 mg/L of BRH sediment (100 BRH), (b) 25 mg/L each of BRH and REF sediment (50-50 BRH/REF), and (c) 50 mg/L REF sediment along (100 REF). This 26-day bioassay demonstrated a significant SFG reduction in mussels exposed to 100 BRH sediment (-3.63 J/hr) and the 50-50 BRH/REF treatment (-2.32 J/hr) compared to mussels exposed to 100 REF sediment (2.53 J/hr). This experiment was replicated to evaluate the reproducibility of the technique. The second experiment produced similar results with the 100 REF treatment mussels having a significantly higher SFG (10.22 J/hr) than both the 50-50 BRH/REF (0.51 J/hr) and 100 BRH (-1.07 J/hr) mussels. The data indicate that in a laboratory exposure the use of the SFG index with M. edulis provides a sensitive and reproducible technique for determining the chronic negative impact due to this dredged material. (Author's abstract)
W88-00841

SPECTROPHOTOMETRIC ANALYSIS OF CHLOROPHYLL A IN FRESHWATER PHYTOPLANKTON,
Hydrological Research Inst., Pretoria (South Africa).
D. P. Sartory.
Technical Report TR 115, January 1982. 163 p, 14 fig, 26 tab, 100 ref.

Descriptors: *Chlorophyll a, *Chlorophyll, *Phaeophyton, South Africa, Phytoplankton, Algae, Pigments, Solvent extraction, Extraction techniques, Sonic mixers, Solvents, Organic solvents, Spectrophotometry.

The analysis of chlorophyll a in water samples, as a means of estimating algal biomass, is especially important in the study of water bodies receiving excessive amounts of plant nutrients, which are thus prone to eutrophication. The work described here entailed a comparative study of analytical techniques, aimed at determining those methodologies that will result in the most accurate measurements of pigments. The importance of this work is stressed because the water supply of South Africa is becoming increasingly limited, and eutrophication is already a major water quality problem in certain areas. The results of this study indicate that ethanol, either as a 95% or 90% aqueous solution, and 100% methanol were superior extraction solvents to 90% acetone and dimethyl sulphoxide (DMSO). For complete extraction from green algae, however, boiling at the solvent's boiling point for 5 min followed by 24 hours standing in the dark was required. Extraction could not take place at room temperature. Homogenization and sonication did not improve extraction of pigments from phytoplankton. (Author's abstract)
W88-00854

STUDY PROGRAM FOR DEVELOPMENT OF INFORMATION FOR USE OF OECD EUTROPHICATION MODELING IN WATER QUALITY MANAGEMENT: A QUALITY CONTROL IN RESERVOIRS COMMITTEE REPORT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. F. Lee, and R. A. Jones.
AWWA Quality Control in Reservoirs Committee Report, October 1980. 35 p, 20 ref.

Descriptors: *Pollutant identification, *Nutrients, *Lakes, *Sampling, *Monitoring, *Eutrophication, Water analysis, Nitrogen, Phosphorus, Water sampling, Model studies, Water quality management, Reservoirs, Chlorophyll, Phytoplankton, Algae, Silica, Stratification, Water temperature, Thermal stratification, Van Dorn sampler, Secchi disks, Ammonia, Phosphates, Nitrates, Conductance.

A minimum monitoring program for management of excessive fertility in domestic water supplies is designed for use in the OECD (Organization for Economic Cooperation and Development) eutrophication model. At least one year's data on nitrogen and phosphorus loads and the eutrophication responses are necessary. To account for year-to-year variability, the following sampling should occur over a three-year period: Jan. 15, Feb. 15, Mar. 15, and April 15, every two weeks during May through Sept., and on Oct. 1, Nov. 1, Dec. 1. Water samples should be collected no less than biweekly from each tributary which contributes >10% of the total nutrient and from the outlet(s). High and low flows should be sampled. Discharge values are obtained daily, either from continuous monitoring or from interpolation of weekly or biweekly measurements. If stratification is present in a tributary, samples should be collected at several places and combined in a composite sample. Nutrient input from atmospheric sources is detected by monthly collection of dustfall and precipitation collectors on the shore or dam. For most lakes and reservoirs a single sampling station is sufficient. For long waterbodies, multiple sampling sites may be necessary if significant arms and poor mixing exist. Parameters which should be measured include dissolved oxygen, temperature, weather conditions, Secchi depth, extent of aquatic macrophyte and algal cover, total phosphorus, soluble orthophosphate, ammonia, nitrate, chlorophyll, specific conductance, pH, organic nitrogen, dominant phytoplankton, alkalinity, silica, and for anoxic specimens, total iron, total manganese, and hydrogen sulfide. (Cassar-PTT)
W88-00869

DESIGN OF 301(H) MONITORING PROGRAMS FOR MUNICIPAL WASTEWATER DISCHARGES TO MARINE WATERS.
Tetra Tech, Inc., Bellevue, WA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-153809. Price codes: A07 in paper copy, A01 in microfiche. Report 430/9-82-010, November 1982. 135 p, 5 fig, 12 tab, 61 ref, append. Contract 68-01-5906.

Descriptors: *Pollutant identification, *Monitoring, *Regulations, *Wastewater disposal, Ocean disposal, Standards, Sampling, Water analysis, Wastewater analysis, Sediments, Quality control, Aquatic life.

This document provides guidance for meeting the general monitoring requirements of the 301(h) program. Chapters include objectives of monitoring (301(h), state, NPDES); treatment plant and effluent monitoring objectives (sampling locations, parameters, sample collection, analytical methods, and toxic substance data reporting); receiving water quality and sediment monitoring objectives; biological monitoring objectives; and quality control. The appendix presents oceanographic methods. (Cassar-PTT)
W88-00896

NIWR INTERLABORATORY COMPARISON STUDY NO 80/A - ANALYSIS OF MAJOR CATIONS AND ANIONS - EVALUATION OF RESULTS,
National Inst. for Water Research, Pretoria (South Africa).
R. Smith.
Council for Scientific and Industrial Research Research Report 379, p 1-30, 1980. 7 fig, 9 tab, 29 append, 10 ref.

Descriptors: *Water analysis, *Wastewater analysis, *Data processing, Cations, Anions, Sulfates, Standards, Indicators, Sample preparation, Potentiometric titrations, Automation, Colorimetry, Comparison studies, Spectral analysis, Hydrogen ion concentration, Calcium, Magnesium, Potassium, Sodium, Chlorides, Methyl orange.

This study is concerned with the analysis of synthetic water samples by 47 laboratories for calcium, magnesium, potassium, sodium, chloride, sulfate and total alkalinity. The results obtained and the methods used are evaluated and discussed. With only a few exceptions, recognized standard methods were used by the participating laboratories. The results highlighted the need for more standardization in the use of interference suppressants in the direct flame atomic absorption determinations of calcium, magnesium, potassium and sodium, as well as in the selection of indicator and end-point pH in the titration methods for the total alkalinity determinations. (USGS)
W88-00945

5B. Sources Of Pollution

RELATIONSHIPS BETWEEN WATER INFILTRATION AND OIL SPILL MIGRATION IN SANDY SOILS,
Coastal and Marine Engineering Research Inst., Haifa (Israel). Dept. of Civil Engineering.
A. Kessler, and H. Rubin.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 187-204, June 15, 1987. 9 fig, 1 tab, 23 ref.

Descriptors: *Path of pollutants, *Oil spills, *Soil contamination, *Sand, *Infiltration rate, *Numerical models, *Model studies, *Data interpretation, Oil pollution, Soil moisture retention, Groundwater pollution, Richard's equation, Mathematical studies, Mathematical models, Mathematical equations, Infiltration, Permeability coefficient, Kerosene.

Prediction of oil spill migration in sandy soils is needed for the design of remedial measures against soil and groundwater contamination. Available data concerning water infiltration was converted into the equivalent of new or unknown data concerning oil spillage and fed into a numerical model by which the oil spill migration was simulated. The methodology for the evaluation of oil spill migration is based on the Richard's equation governing unsaturated water flow. Agreement between experimental and theoretical results of tests measuring the parameters for kerosene flow in Caesarian sand and use of the parameters in predicting the advancement rate of a kerosene front in a column of this soil justified the application of unsaturated flow principles for the simulation of oil spill migration. Laboratory measurements including retention curve, hydraulic conductivity and infiltration rate were made separately for water and kerosene in order to evaluate and confirm the suggested approach. (Wood-PTT)
W88-00003

VOCS IN GROUND WATER INFLUENCED BY LARGE SCALE WITHDRAWALS,
Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources.
A. J. Fischer, E. A. Rowan, and R. F. Spalding.
Ground Water GRWAAP, Vol. 25, No. 4, p 407-

414, July-August 1987. 4 fig, 2 tab, 32 ref.

Descriptors: *Monitoring, *Volatile organic compounds, *Groundwater pollution, *Path of pollutants, *Groundwater level, *Water table, *Water table decline, *Computer models, Data interpretation, Groundwater, Monitoring wells, Hastings, Nebraska, Trichloroethylene, Organic compounds, Pollutants, Water pollution, Vertical distribution, Distribution patterns, Distribution, Wells, Pumping, Model studies.

Ten wells were installed to monitor the water-table elevation and volatile organic compounds (VOCs) in groundwater underlying Hastings, Nebraska. Trichloroethylene was the most frequently detected VOC and had the highest concentration (1750 micrograms/liter) in these monitoring wells. Perchloroethylene and 1,1-dichloroethylene, 1,2-dichloroethane, and 1,1,1-trichloroethane also occurred in one or more of the monitoring wells. The vertical and areal VOC distribution in both the contaminated monitoring wells and the city's contaminated municipal wells are largely related to withdrawal caused by heavily pumped, nearby municipal and industrial wells. A computer model was used to demonstrate the impact historic site changes in high capacity well withdrawal have on the local water-table configuration. Two sites of suspected VOC sources are designated for further investigation. (Author's abstract)
W88-00014

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART 2. CASE STUDIES,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 7B.
W88-00016

STOCHASTIC MODELING OF THE INSECTICIDE FENITROTHION IN WATER AND SEDIMENT COMPARTMENTS OF A STAGNANT POND,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
R. Leduc, T. E. Unny, and E. A. McBean.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1105-1112, July 1987. 4 fig, 22 ref, 2 append.

Descriptors: *Fate of pollutants, *Fenitrothion, *Insecticides, *Organophosphorus pesticides, *Stagnant water, *Ponds, *Model studies, *Data interpretation, Path of pollutants, Insecticide decomposition, Canada, New Brunswick, Bottom sediments, Sediments, Pesticide kinetics, Kinetics, Mathematical equations, Mathematical studies, Differential equations, Spraying.

A stochastic model was developed for the decomposition of the insecticide fenitrothion in a New Brunswick (Canada) stagnant pond after aerial spraying. The concentrations of fenitrothion are modeled in two pond compartments: water and bottom sediments. Assuming first-order kinetics, a mass balance equation of fenitrothion was written for each of the compartments. The deterministic model was obtained by integrating the linear system of differential equations. The stochastic model arises by considering both the initial condition in the water compartment and the input term in the sediment compartment to be stochastic, which results in a stochastic differential equation (SDE). The moment equation, derived from the Ito stochastic differential rule, provides the moment solution to the SDE. Temporal expectations and heteroscedastic variance models are obtained. The model was calibrated using observations obtained from fenitrothion sampling at three different locations in each of the pond's compartments. The stochastic model performs satisfactorily. (Author's abstract)
W88-00021

INTRODUCTION OF THE STREAM FUNCTION CONCEPT TO THE ANALYSIS OF HYDRODYNAMIC DISPERSION IN POROUS MEDIA,
International Technology Corp., Monroeville, PA.
V. Batu.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1175-1184, July 1987. 6 fig, 9 ref, 3 append.

Descriptors: *Dispersion, *Hydrodynamic dispersion, *Porous media, *Solute transport, *Path of pollutants, *Groundwater movement, *Stream function, Mathematical studies, Mathematical equations, Differential equations, Seepage, Solutes.

The stream function concept is introduced to the analysis of hydrodynamic dispersion in porous media. The governing partial differential equation for the stream function for two-dimensional flow under steady state water and solute transport conditions in an isotropic porous medium was derived. For a uniform seepage velocity, the corresponding differential equation was obtained as a special case. The equation for the axially symmetric solute transport case was also derived. The isoconcentration curves and the hydrodynamic dispersion stream lines are not orthogonal to each other. For the uniform seepage velocity case, general solutions are presented for concentration distribution and hydrodynamic dispersion stream function (HDSF) for strip sources having variable concentration distributions. Special solutions are presented for concentration, HDSF, and convective-dispersive flux components for a strip source having constant concentration. The concept of hydrodynamic dispersion bounding streamline separating the solute transport zone from other zones is also introduced. The methodology of the HDSF concepts and the solutions for some idealized cases can be applied for contaminant plume analysis, computer model validation, and other hydrogeological studies. (Author's abstract)
W88-00029

ANALYTICAL SOLUTIONS FOR RADIAL DISPERSION WITH CAUCHY BOUNDARY AT INJECTION WELL,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
C.-S. Chen.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1217-1224, July 1987. 5 fig, 15 ref, append.
NSF Grant ECE-8696079.

Descriptors: *Dispersion, *Solute transport, *Radial dispersion, *Cauchy boundary conditions, *Path of pollutants, *Injection wells, *Aquifers, *Groundwater, Mathematical equations, Mathematical studies, Interfaces, Injection, Advection.

In dealing with solute transport from an injection well into an aquifer a macroscopic boundary condition of the Cauchy type (the third type) can be formulated at the well-aquifer interface if the mass balance principal is invoked. This Cauchy boundary condition includes effects of radial advection and longitudinal dispersion as molecular diffusion is neglected in the problem. Analytical solutions related to a continuous and pulse injection were determined for the radial dispersion problem concerning such a Cauchy boundary condition. These solutions give resident concentrations in the radial flow system. Results of the continuous injection solution and of that related to a Dirichlet boundary condition (the first type) were different for short injection periods but converged for long periods. The deviation caused by using two different boundary conditions was further studied with appropriate asymptotic solutions valid only for short injection periods. It was found that significant concentration gradients may exist across the well-aquifer interface for short injection periods. Under this condition, neglect of the local dispersion process at the well-aquifer interface (as assumed in the Dirichlet boundary condition) amounts to forcing more solute mass into the aquifer. As injection is prolonged, the concentration gradient across the interface decreases as the associated local aquifer concentration is increased to the injected concentration level. For relatively long injection periods, a local concentration equilibrium at the well-aquifer interface is reached and thereafter advection dominates the local transport. The Dirichlet boundary condition is a special case neglecting local dispersion at the well bore to the Cauchy boundary condition. For the radial dispersion equation, solutions regarding a Dirichlet boundary condition do not give the flux concentrations due to the nonconstant groundwater velocity. Nevertheless, solutions of flux concentrations for a continuous and a pulse injection may be acquired by applying the flux concentration transformation to appropriate solutions regarding the Cauchy boundary condition. (Author's abstract)
W88-00033

EFFECT OF SOIL WATER HYSTERESIS ON SOLUTE MOVEMENT DURING INTERMITTENT LEACHING,
University of New England, Armidale (Australia). Dept. of Resource Engineering.
M. J. Jones, and K. K. Watson.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1251-1256, July 1987. 9 fig, 10 ref.

Descriptors: *Solute transport, *Hysteresis, *Soil water, *Path of pollutants, *Leaching, Intermittent leaching, Mathematical studies, Mathematical equations, Dispersion equation, Model studies, Solutes, Computers.

The use of a computer-based numerical solution of the hydrodynamic dispersion equation was coupled with a program for the movement of soil water incorporating an interpolative hysteresis model. Results are presented for nonreactive solute movement during an intermittent leaching regime under a constant concentration boundary condition at the surface, both including and excluding the effects of soil water hysteresis. When hysteresis data was included in the analysis, the solute mass profiles indicated that the solute moves through the soil profile in a series of well-defined peaks. This is in marked contrast to the situation in which hysteresis is neglected. For this case the well-defined peaks disappear after the first infiltration event, and the solute becomes fairly uniformly distributed much deeper in the profile. In the sphere of field management, it appears that under appropriate conditions relating to soil type and depth to water table, an intermittent leaching regime could be used both to control the movement of salt and to limit water use, so that the salt could be removed from a root-sensitive area without purging it through to the groundwater system. (Wood-PTT)
W88-00036

KINEMATIC WAVE APPROXIMATION TO THE TRANSPORT OF ESCHERICHIA COLI IN THE VADOSE ZONE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Soils and Crops.
P. F. Germann, M. S. Smith, and G. W. Thomas.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1281-1287, July 1987. 4 fig, 3 tab, 24 ref.
USEPA Agreement R811528-01-0.

Descriptors: *Microbial transport, *Path of pollutants, *Kinematic wave theory, *Vadose zone, *Macroporous soils, *Escherichia coli, Bacteria, Kinematic waves, Soil bacteria, Soil water, Conductance, Mathematical equations.

Threshold values for macropore flow parameters that are thought to be critical in the transport of microbial suspensions through macroporous soils were established through the application of a kinematic wave approach to bacterial breakthrough curves. According to the presented examples, moisture content and conductance in the macropore systems of four different soils had to exceed 0.015 (cu m/cu m) and 0.1 (m/s) simultaneously, respectively, before substantial microbial breakthrough was observed at the bottom of undisturbed columns of macroporous soils with lengths ranging from 0.21 to 0.32 m. The application of these thresholds in a modeling approach to large-scale flow revealed that hardly any microbes can be transported deeper than 2-3 m in soils when durations and intensities of naturally occurring precipitation events were entered into the model. It was also shown, however, that prolonged or intensified water input to the soil surface may efficiently carry

microbes deeper than 100 m into the vadose zone. (Author's abstract)
W88-00039

THM FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5A.
W88-00065

LACK OF BIOACCUMULATION OF METALS BY ELLIPTIO COMPLANATA (BIVALVIA) DURING ACIDIC SNOWMELT IN THREE SOUTH-CENTRAL ONTARIO STREAMS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5A.
W88-00080

GROWTH OF BACTERIA IN AN OIL SHALE RETORT WATER BY INDIGENOUS MICROORGANISMS,
South Dakota State Univ., Brookings. Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W88-00081

LEACHING OF CHEMICAL CONTAMINANTS FROM A MUNICIPAL LANDFILL SITE,
Moncton Univ. (New Brunswick). Dept. of Chemistry.
F. Cyr, M. C. Mehra, and V. N. Mallet.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 775-782, May 1987. 1 fig, 5 tab, 8 ref.

Descriptors: *Water pollution sources, *Landfills, *Leachates, *Moncton, Canada, Sediment analysis, Heavy metals, Water quality, Inorganic pollutants, Physicochemical properties, Atomic absorbtion spectrophotometry.

The physicochemical nature of leachates from three landfill sites in Moncton, their inorganic contents and in particular their heavy metals concentrations are described. Water quality and the physicochemical parameters such as pH, conductivity, total alkalinity, total organic carbon, total inorganic carbon, hardness, chemical oxygen demand, nitrite-nitrate, chloride, and sulfate were measured. Except for Hg and As, all metals were analyzed by flame atomic absorption spectrophotometry. Hg and As were analyzed by flameless atomic absorption spectroscopy. The river bed sediments were analyzed for heavy metal accumulation. Test results indicate chemical contaminates are being released from the Moncton City landfill, but the levels are within an acceptable range. (Main-PTT)
W88-00082

SIMPLE WET-ONLY RAINFALL COLLECTOR,
Newcastle Univ. (Australia). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W88-00097

COPPER ACTIVITY IN SOIL SOLUTION: II. RELATION TO COPPER ACCUMULATION IN YOUNG SNAPBEANS,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5A.
W88-00105

TRACE ELEMENTS IN THE ENVIRONMENT AND IN HUMAN ORGANS. I. METHODS AND RESULTS,
Station of Public Health and Epidemiology in Borsod County, Miskolc (Hungary).
S. Takacs, and A. Tatar.
Environmental Research ENVRAL, Vol. 42, No. 2, p 312-320, April 1987. 5 tab, 25 ref.

Descriptors: *Path of pollutants, *Drinking water, *Trace elements, *Trace metals, *Copper, *Zinc, *Lead, *Cadmium, *Hungary, Tissue analysis, Kidneys, Lung.

The copper, zinc, lead, and cadmium content of the kidney, liver, lung, and adrenal derived from 1072 autopsies was determined by spectrophotometry. The metallic content of food and drink was examined and the daily quantity consumed was stated by measuring and calculation. According to the results in Hungary the daily ingestion of these four microelements in Hungary is small, as reflected by the metal content of the organs. An average 75% of the kidney's whole cadmium content is present in the cortex. Lead in the medulla and zinc in the cortex are found in larger quantities. Analyzing the distribution according to sexes it was found that lead in the liver and kidney and cadmium in the kidney and lung of women is much lower than in men. However, the element content in the adrenal is significantly higher for zinc and cadmium in women. The cadmium distribution in the kidney is similar to the essential elements. The correlation of the element pairs is better in the kidney and lung (Zn-Cu is 0.55 in the kidney and 0.51 in the lung) The amount of copper, lead, and cadmium was relatively low in drinking water and food. Because of this, the uptake of the essential (copper, zinc) and of the toxic (lead, cadmium) elements in Hungary is equal to or below the international level. Since the amount of copper and zinc ingested in the drinking water (and from the air) is negligible, only changes in feeding habits will reesult in some improvement. (Master-PTT)
W88-00117

INTER-STORM COMPARISONS FROM THE OSCAR HIGH DENSITY NETWORK EXPERIMENT,
E. G. Chapman, D. J. Luecken, M. T. Dana, R. C. Easter, and J. M. Hales.
Atmospheric Environment ATENBP, Vol. 21, No. 3, p 531-549, March 1987. 13 fig, 3 tab, 32 ref.

Descriptors: Descriptors:*Precipitation, *Cyclonic precipitation, *Acid rain, *Precipitation, *Rainstorms, *Path of pollutants, *Air pollution, *Remote sensing, Sulfur dioxide scavenging, Cyclonic storms, OSCAR, Indiana, Scavenging.

The high density network component of the Oxidation and Scavenging characteristics of April Rains (OSCAR) experiment combined aircraft, surface and sequential precipitation chemistry measurements to characterize the physicochemical and dynamic features of four storms sampled during an April 1981 field investigation. A surface network of 47 precipitation sampling stations, covering a region roughly 110 km by 110 km, was established in the area surrounding Fort Wayne, Indiana. The network provided temporal and spatial resolution of rainfall chemistry via the use of specially designed automatic sequential bulk precipitation collectors, while aircraft and surface sampling provided measurments of the major aerosols and trace gases in the boundary- layer inflow region. Composite concentration and ion ratio profiles for the events were analyzed to investigate potential pollutant scavenging pathways. This analysis led to the following observations: dryfall deposition during pre-rainfall exposure periods influenced initial sampler stage chemistry; relative precipitation acidity increased throughout the events; SO4 and NO3 were the major contributors to this acidity; evidence exists for the in-cloud oxidation of SO2 during Events 3 and 4, while scavenging of HNO3 and aerosol NO3 probably produced precipitation NO3; the non-frontal meteorology of Event 3 influenced the precipitation chemistry associated with this storm and led to distinct concentration profiles; an anomalous pattern of NH4 concentrations observed during Event 1 cannot be explained by known NH4 scavenging behavior or by non-scavenging related influences, such as local source contamination or NH3 volatilization; Event 4 is more suitable for analysis by one- and two-dimensional diagnostic wet removal models. Analysis of the other events is complicated by more complex meteorlogical behavior and, in some cases, a less complete chemistry data set. (Author's abstract)
W88-00120

CHEMICAL SURVEY OF THE MISSISSIPPI ESTUARY,
Harvard Univ., Cambridge, MA. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2L.
W88-00133

DYNAMICS OF POLYCHLORINATED BIPHENYLS IN STRIPED BASS FROM THE HUDSON RIVER: III. TISSUE DISPOSITION AND ROUTES FOR ELIMINATION,
New York Univ. Medical Center, Tuxedo Park. Inst. of Environmental Medicine.
J. M. O'Connor, and J. C. Pizza.
Estuaries ESTUDO, Vol. 10, No. 1, p 68-77, March 1987. 3 fig, 6 tab, 43 ref. National Institutes of Environmental Health Sciences Center Grant No. ES00260.

Descriptors: *Polychlorinated biphenyls, *Bass, *Path of pollutants, *Fate of pollutants, *Chlorinated hydrocarbons, Tissue deposition, Hudson River, Pollutants, Carbon radioisotopes, Fish physiology, Liver.

Striped bass were exposed to C14-polychlorinated biphenyls (PCBs) in single-dose and multiple-dose experiments. Samples were analyzed to determine rate constants for PCB elimination from individual tissues, PCB concentration in tissues, the proportion of the PCB burden retained and the proportion of the cumulative dose retained by each tissue at various times after exposure. An experiment was also conducted to determine both the potential for secondary PCB uptake in dietary exposure studies and the relative tissue disposition of PCBs assimilated from dietary sources as compared to direct water uptake. PCBs were present in the tissues of striped bass within 6 hours after administration of a single dose. Certain tissue compartments, such as the liver/gall bladder, accumulated PCBs over a period of 48 hours even though the whole-body burden had decreased between 24 and 48 hours. Except for the gills, elimination rate constants for all tissues were similar and were similar to the whole body elimination rate constant. Elimination during the first few hours following exposure to PCBs may be due to equilibrium partitioning from the gill to the environment. The multiple-dose study showed that PCB burdens in striped bass continued to increase with dosing. However, tissue-specific rate constants for PCB elimination led to an increased flux of PCB out of tissues, and an overall decline in the percent of the cumulative dose remaining in the body 48 hours after administration of each dose. The most likely route for PCB elimination from striped bass was from tissues to the liver and thence to the intestine via the bile. There were no differences in the tissue disposition of PCB related to route of exposure. (Author's abstract)
W88-00141

MERCURY-BINDING PROTEINS IN THE SLIPPER LIMPET, CREPIDULA FORNICATA, EXPOSED TO INCREASED SOLUBLE MERCURY,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
F. L. Harrison, K. Watness, D. A. Nelson, J. E. Miller, and A. Calabrese.
Estuaries ESTUDO, Vol. 10, No. 1, p 78-83, March 1987. 4 fig, 19 ref. DOE Contract No. W-7405-ENG-48.

Descriptors: *Mercury, *Mollusks, *Fate of pollutants, *Path of pollutants, *Water pollution effects, *Proteins, Slipper limpet, Heavy metals, Chromatography, Spectrometry, Mortality, Lethal limit, Toxicity, Tolerance.

Crepidula fornicata were held in a flow-through bioassay system and exposed to sand-filtered seawater to which no soluble mercury (control) was added or to which either 5, 25, or 50 micrograms/liter soluble Hg was added. At specific intervals during the 16-week experiment, a group of limpets was removed from each tank; one subgroup was exposed for 48 hours to high concentrations of Hg, and another was analyzed for Hg-binding proteins

by gel-permeation chromatography and spectrometry. Mortality from exposure to Hg in the 48-hour acute toxicity tests was related to concentrations of Hg experienced both during the long-term exposure period and the 48-hour exposure period. Chronic exposure to low levels of Hg resulted in increased amounts of total Hg in the whole body and in the low-molecular-weight Hg-binding proteins. No evidence was found for increased tolerance to Hg with pre-exposure. (Author's abstract)
W88-00142

WATERBORNE OUTBREAK OF LEPTOSPIROSIS,
Istituto Superiore di Sanita, Rome (Italy).
For primary bibliographic entry see Field 5C.
W88-00154

VIRUS UPTAKE BY MINERALS AND SOILS,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
G. W. Fuhs, and D. H. Taylor.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 603-640, 11 fig, 3 tab, 113 ref.

Descriptors: *Wastewater management, *Water reuse, *Viruses, Wastewater treatment, Waste management, Wastewater, Municipal wastewater, Wastewater disposal, Wastewater renovation.

Adsorption of human viruses to minerals and soils is an important consideration in the reuse of treated wastewater through groundwater recharge. At present no general formula is available to predict uptake of any virus by any soil. However, once viruses are adsorbed to soil they can easily be removed if pH is maintained near or below neutrality and if divalent catonic species are present. For the practical application of these findings the authors recommend adequate testing of physical and mineralogic characteristics of the recharge area (surface area, equilibrium pH, organic content) when a soil-recharge system is being planned. In theory, portions of the total removal efficiency can be allocated among the wastewater treatment and the recharge components of the system, but uncertainties in the reliability of each of the components dictate a conservative approach to such allocations. However, several processes have been shown to benefit virus removal during treatment and improve the performance of recharge beds. They include flocculation-precipitation reactions, followed by sedimentation and dual-media filtration. Data presented indicate that saturation of the recharge beds will hardly, if ever, occur even in a long-term operation. Shortcuts to advanced wastewater treatment are acceptable only where the aquifer is not intended to provide potable water. (See also W88-00164) (Halterman-PTT)
W88-00190

DEPOSITION BOTH WET AND DRY.
Acid Precipitation Series, Volume 4, Butterworth Publishers, Boston. 1984. Volume edited by Bruce B. Hicks. Series edited by John I. Teasley. 197 p.

Descriptors: *Acid rain, *Air pollution, *Fate of pollutants, *Symposium, *Chemistry of precipitation, Monitoring, Acidic water, Chemical properties, Case studies, Ions, Nitrogen, Sulfates, Path of pollutants, Networks, Precipitation.

The volumes of the Acid Precipitations Series are a result of a symposium on Acid Precipitation held in conjunction with the American Chemical Society's Las Vegas meeting, held in the Spring of 1982. The symposium was designed to present findings on atmospheric movement of the precursors of acid precipitation; atmospheric chemistry and precipitation effects including aquatic, terrestrial and geochemical; the economics involved with acid rain; and mathematical modeling in order that future problems may be predicted. Volume 4 is intended to give a cross-section of recent work on documenting characteristics of the acid deposition phenomenon itself, usually by means of network studies, but also in intensive case studies. Topics covered include: evaluation of wet chemical deposition in North America; acidic pollutants in air and precipitation at selected rural locations in Canada; combined analysis of air quality and precipitation chemistry data; comparison of wet deposition composition at coastal and inland sites in east-Central Florida; nature of precipitation and atmospheric particulates in Central and Northern New Mexico; the OSCAR (Oxidation and Scavenging Characteristics of April Rains) experiment; field intercomparison of sulfate dry deposition monitoring and measurement methods; solubility of metal ions in rainwater; and dry deposition of nitrogen-containing species. (See W88-00096 thru W87-12302) (Geiger-PTT)
W88-00222

EVALUATION OF WET CHEMICAL DEPOSITION IN NORTH AMERICA,
Colorado State Univ., Fort Collins. Natural Resources Ecology Lab.
J. H. Gibson.
IN: Acid Precipitation Series, Volume 4: Deposition both Wet and Dry, Butterworth Publishers, Boston. 1984. p 1-13, 7 fig, 2 tab, 3 ref.

Descriptors: *Acid rain, *Air pollution, *Monitoring, *Chemistry of precipitation, *Networks, Acidic water, Fate of pollutants, Chemical properties, Nitrogen compounds, Sulfates, Path of pollutants, Precipitation, Nitrates, Nitrogen, Data collections, Hydrogen ion concentration.

Data from the U.S. National Atmospheric Deposition Program (NADP) and the Canadian Network for Sampling Precipitation (CANSAP) networks are sufficient to permit the analysis of spatial and short-term temporal trends in wet chemical deposition in North America. Results from these data suggest that the eastern and northeastern United States and southeastern Canada are receiving significant levels of deposition. There is a high correlation of acidity with sulfate levels and evidence that anthropogenic sources of sulfur and nitrogen oxides are the principal contributors to acid deposition. The spatial distribution of the pH of rainfall is also controlled by the concentration of neutralizing species such as calcium and ammonia. In many areas of the west, the concentrations of nitrate and sulfate are now equivalent to or exceeding those of calcium and ammonia. Because acidity is a result of total precipitation chemistry, measurements of trends in sulfate and nitrate levels are more critical than those of hydrogen ion levels when researchers assess the effectiveness of measures to reduce acid deposition. Long-term monitoring programs (> 10 yr) are needed to study future trends because of year-to-year variations. Such long-term data are critical for evaluating the regional impacts of increasing or decreasing emissions. (See also W88-00208) (Geiger-PTT)
W88-00223

ACIDIC POLLUTANTS IN AIR AND PRECIPITATION AT SELECTED RURAL LOCATIONS IN CANADA,
Atmospheric Environment Service, Downsview (Ontario).
L. A. Barrie, K. Anlauf, H. A. Wiebe, and P. Fellin.
IN: Acid Precipitation Series, Volume 4: Deposition both Wet and Dry, Butterworth Publishers, Boston. 1984. p 15-35, 13 fig, 3 tab, 16 ref.

Descriptors: *Acid rain, *Air pollution, *Monitoring, *Chemistry of precipitation, *Networks, Acidic water, Chemical properties, Ions, Nitrogen compounds, Seasonal variations, Sulfates, Path of pollutants, Precipitation, Nitrates, Nitrogen, Data collections, Hydrogen ion concentration, Rural areas, Sulfur compounds.

The Air and Precipitation Monitoring Network, along with other precipitation chemistry networks in Canada has begun to yield data on the occurrence of pollutants in time and space. At locations in eastern Canada downwind of major continental source regions, levels of sulfur dioxide and sulfates in the atmosphere undergo strong seasonal variations. Sulfate concentrations are a maximum in summer, a minimum in winter. Sulfur dioxide levels peak in winter and dip lowest in summer. The spatial scale of sulfur dioxide pollution is, on the average, smaller than that of particulate sulfate. Concentrations of sulfur dioxide decrease more rapidly with distance from the source region than do those of sulfate. Precipitation is most acidic in southern Ontario, least acidic in northwestern Ontario. Seasonal variations of the concentration of acid-related ions in precipitation occur for sulfate and to a lesser extent, for nitrate but not at all for hydrogen ions. Dry deposition of sulfur compounds is generally less than or equal to wet deposition. Its importance relative to wet deposition decreases with increasing distance from source regions. Measurements of precipitation chemistry over the next few years will provide insight into the processes that produce acid rain and trends in acidity associated with changes in emissions in Canada. (See also W88-00208) (Geiger-PTT)
W88-00224

COMBINED ANALYSIS OF AIR QUALITY AND PRECIPITATION CHEMISTRY DATA,
Environmental Research and Technology, Inc., Westlake Village, CA.
G. M. Hidy, and R. Countess.
IN: Acid Precipitation Series, Volume 4: Deposition both Wet and Dry, Butterworth Publishers, Boston. 1984. p 37-62, 4 fig, 6 tab, 16 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Nitrogen compounds, *Sulfur compounds, *Chemical properties, Anions, Cations, Monitoring, Acidic water, Seasonal variations, Sulfates, Nitrites, Data collections, Rainfall, Metals, Air pollution, Ions.

In the absence of extensive direct observations of in-cloud processes, ground-based observations can provide useful surrogate measures of scavenging processes. Simultaneous observations of sulfur oxide and nitrogen oxide concentrations in the air and precipitation have been used to calculate ratios corresponding to Junge's rainout efficiency, cation-to-sulfate ratios and partial anion-cation budgets compared with hydrogen ion concentrations. Average sulfate rainout efficiencies based on particulate sulfate are 0.6-0.8, depending on the the liquid water content model used. Nitrate efficiencies based on particulate nitrate were found to be much larger than unity. In the eastern United States, there generally is sufficient particulate sulfate in the air to account for precipitation sulfate through removal by water nucleation on the particles. Nitrate concentrations in precipitation can be explained by the scavenging of nitric acid or oxides of weak-to modest seasonal dependence, with smaller values in winter. Comparison of particulate and rainwater sulfate concentrations with alkaline metal concentrations for a few available cases suggests enrichment of sulfate in rainwater relative to the metals in particles. Examination of particulate vs. rainwater cation and anion concentrations for a few cases for Pennsylvania and Delaware suggest that anions are dominated by sulfate in particles, but sulfate and nitrate contribute more equally in rainwater. (See also W88-00208) (Geiger-PTT)
W88-00225

COMPARISON OF WET DEPOSITION COMPOSITION AT COASTAL AND INLAND SITES IN EAST-CENTRAL FLORIDA,
University of Central Florida, Orlando. Dept. of Chemistry.
B. C. Madsen.
IN: Acid Precipitation Series, Volume 4: Deposition both Wet and Dry, Butterworth Publishers, Boston. 1984. p 63-77, 5 fig, 5 tab, 13 ref. Contract Nos. NAS10-8986 and NAS10-9841.

Descriptors: *Deposition, *Acid rain, *Ions, *Chemistry of precipitation, *Chemical properties, Anions, Cations, Monitoring, Sulfates, Nitrates, Nitrites, Nitrogen compounds, Sulfur compounds, Data collections, Rainfall, Hydrogen ion concentration, Air pollution, Statistical analysis.

During the period July 1977 to September 1981, wet deposition was collected from several sites at or near Kennedy Space Center, Florida, and at a single site on the University of Central Florida campus located east of Orlando. Results were analyzed in terms of annual weighted averages for

four separate periods, 49 monthly weighted averages as a group, and daily sampling in each of the four annual periods. The H, NO3 and SO4 ion composition of wet deposition in east-central Florida was found to be similar at sites separated by 50 km or less. A rapid decline was noted in the contribution of marine-derived constituents in wet deposition as site distance from the ocean increased. Statistical analysis of data suggests that somewhat anomalous behavior is observed at one site located at the seashore; however, the acidity and related chemical species concentrations are not significantly affected. (See also W88-00208) (Geiger-PTT)
W88-00226

NATURE OF PRECIPITATION AND ATMOSPHERIC PARTICULATES IN CENTRAL AND NORTHERN NEW MEXICO,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.
C. J. Popp, R. W. Ohline, D. K. Brandvold, and L. A. Brandvold.
IN: Acid Precipitation Series, Volume 4: Deposition both Wet and Dry, Butterworth Publishers, Boston. 1984. p 79-95, 2 fig, 12 tab, 18 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Chemical properties, *Air pollution, *Particulate matter, Deposition, Anions, Cations, Monitoring, Acidic water, Ions, Sulfates, Nitrates, Nitrites, Nitrogen compounds, Sulfur compounds, Data collections, Rainfall, Hydrogen ion concentration, Calcium, Chlorine, Sodium, Fly ash.

The chemistry of the precipitation and the nature and distribution of atmospheric particulates in washout and air filters in an expanded study area in central and northern New Mexico have been investigated over a one- to three-year period. Average pH values for precipitation in the arid, high desert and mountain regions of central and northern New Mexico are lower than expected for CO2 equilibrium and range from 4.7 to 5.5 on an event basis. Volume-weighted averages are lower and indicate greater acid contribution from larger events. Terrestrially derived atmospheric particulates play a major role in neutralizing acidity in low-volume precipitation events. Reaction of calcareous material lowers SO4/Ca ratios in precipitation as a function of time of exposure of the precipitation with washout particulate matter. Fly ash particle number densities were calculated for precipitation washout. Cl/Na ratios were high when both of the ions originate from the exposure of precipitation to regional terrestrial material. The nitric acid contribution to the acidity as reflected in NO3/SO4 ratios appears to be large considering the amount of sulfate contributed from entrainment processes. Winter NO3/SO4 ratios are high in Albuquerque during temperature inversions, and high NO3/SO4 ratios are observed in precipitation collected in thunderstorms at high altitudes. (See also W88-00208) (Geiger-PTT)
W88-00227

OSCAR EXPERIMENT,
Battelle Pacific Northwest Labs., Richland, WA.
R. C. Easter.
IN: Acid Precipitation Series, Volume 4: Deposition both Wet and Dry, Butterworth Publishers, Boston. 1984. p 97-120, 17 fig, 4 tab, 9 ref.

Descriptors: *Sulfur, *Nitrogen, *Networks, *Meterological data collections, *Cyclones, *Air pollution, Oxides, Nitrates, Nitrogen compounds, Sulfur compounds, Data collections, Deposition, Storms, Clouds, Acid rain, Sulfates, Oxidation.

The OSCAR (Oxidation and Scavenging Characteristics of April Rains) experiment, a cooperative field study of wet removal by cyclonic storms, was carried out to characterize the physicochemical and dynamical features of selected cyclonic or frontal storms as they traverse the eastern United States. A 37-station intermediate-density network provided regional coverage over the eastern United States while a 47-site high-density network was located in a 10,000 sq km area in northeastern Indiana, where intensive investigations into wet removal mechanisms were made. Four storm events were studied during the experiment. Preliminary results at the high-density network from one of the storm events suggest that scavenging and in-cloud oxidation of SO2 apparently contributed more than twice as much to sulfur wet deposition as did scavenging of existing sulfate aerosol. Tentative measurements of hydrogen peroxide in rainwater samples support the aqueous phase H2O2-SO2 reaction as a major oxidation mechanism. Temporal features of the wet deposition during the storm showed a rapid depletion of sulfur pollutants by wet removal. Scavenging of existing nitrate aerosol, nitric acid and peroxyacetyl nitrate all contributed to nitrogen oxide wet deposition, although the data indicate that these species may not account for all of the nitrate found in precipitation in the storm. (See also W88-00208) (Geiger-PTT)
W88-00228

SOLUBILITY OF METAL IONS IN RAINWATER,
Illinois State Water Survey Div., Champaign. Atmospheric Chemistry Section.
D. F. Gatz, B. K. Warner, and L. C. Chu.
IN: Acid Precipitation Series, Volume 4: Deposition both Wet and Dry, Butterworth Publishers, Boston. 1984. p 133-151, 8 fig, 4 tab, 27 ref.

Descriptors: *Acid rain, *Ions, *Solubility, *Chemistry of precipitation, *Metals, Deposition, Rain, Anions, Cations, Water pollution sources, Monitoring, Fate of pollutants, Acidic water, Hydrogen ion concentration, Lead, Iron, Cadmium, Zinc, Copper, Heavy metals, Data collections, Rainfall, Chemical properties, Air pollution.

Soluble and insoluble metals, and major cations and anions were measured in weekly wet, dry and bulk precipitation samples collected in suburban Chicago during 59 sampling periods from December 1979 to March 1981. Distributions of percent soluble metals show differences in solubility between metals (Zn=Cd>Cu>Pb) and differences for all metals between sample types (wet>bulk=dry). Total insoluble mass concentration is a good index of clay mineral concentration, but is composed of other materials as well, since the observed abundance of insoluble Al in the samples was less than that of the major clay minerals. Metal solubility in precipitation is similar to that of other natural waters; solubility decreases as pH and the concentrations of total mass and insoluble Fe increase. This variation of metal solubility with the concentrations of insoluble materials explains why metals are less soluble in dry and bulk samples than in wet samples. For both Zn and Pb, the wet and bulk samples show consistent patterns, with the wet samples on the whole having smaller total insoluble consistent mass concentrations and higher percent solubility values. These results have important implications for precipitation sampling and sample preparation methodology, as well as for understanding metal chemistry in precipitation, airborne metals scavenging processes, metals as tracers for sources of acidity and effects of acid precipitation on ecosystems. (See also W88-00208) (Geiger-PTT)
W88-00229

EVALUATING THE FECAL CONTAMINATION IN FRUITS AND VEGETABLES FROM MARKETS IN MEXICO CITY,
Universidad Nacional Autonoma de Mexico, Mexico City. Dept. of Human Ecology.
For primary bibliographic entry see Field 3C.
W88-00284

ENVIRONMENTAL POLLUTION AND CONTROL,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
2nd. Edition. Butterworth, Boston, MA. 1983. 395 p.

Descriptors: *Water quality control, *Water pollution control, *Wastewater treatment, Water treatment, Sludge treatment, Sludge disposal, Pollutant identification, Industrial wastes, Environmental engineering.

This book presents the important aspects of environmental engineering to a nonengineering audience. Among the water-related topics are pollution, measurement of water quality, water supply and distribution, water treatment, wastewater collection and treatment, sludge treatment and disposal, nonpoint source pollution, law, and hazardous waste disposal. (See W88-00331 thru W88-00338) (Cassar-PTT)
W88-00330

WATER POLLUTION,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
IN: Environmental Pollution and Control, 2nd edition. Butterworth, Boston, MA. 1983. p 7-34, 11 fig, 2 tab.

Descriptors: *Water pollution sources, *Water pollution effects, *Industrial wastes, Municipal wastes, Agricultural wastes, Ecology, Biodegradation, Degradation, Aerobic digestion, Anaerobic digestion, Streams, Oxygen, Aeration, Dissolved oxygen, Aquatic life, Oxygen demand, Lakes, Eutrophication, Algae, Phosphorus, Nutrients.

Industrial waste, including heavy metals, unknown chemicals, and heat, is probably the greatest single water pollution problem. Municipal waste is the second most important water pollution source. A particular problem is the combined storm and sanitary sewer system used in most older cities. Other pollutants are agricultural wastes, sediment from land erosion, oil spills, and acid mine drainage. Aerobic and anaerobic decomposition are summarized. Organic pollutants discharged into a stream use oxygen for decomposition. Oxygen dynamics can be calculated from formulas and curves. Reaeration constants vary from 0.1-0.23 per day for small ponds to >1.15 per day in rapids. The effects of pollution on aquatic life are described. Lake pollution differs from stream pollution in that light and temperature have significant effects. Phosphorus compounds have an important role in lake eutrophication. (See also W88-00314) (Cassar-PTT)
W88-00331

NONPOINT SOURCE WATER POLLUTION,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
IN: Environmental Pollution and Control, 2nd edition. Butterworth, Boston, MA. 1983. p 129-140.

Descriptors: *Water pollution sources, *Water quality control, *Nonpoint pollution sources, *Water pollution prevention, *Erosion control, Agriculture, Forest management, Urban runoff, Storm runoff, Sediment transport, Silt, Soil stabilization, Vegetation, Terracing, Construction, Mine drainage, Mine wastes, Environmental effects, Watershed management, Storm wastewater.

Nonpoint source pollution is a result of rainfall runoff. The number of soil particles dislodged and transported to water bodies depends on the characteristics of the rain, the soil characteristics, slope factors, and land cover conditions. The portion of soil actually delivered to the receiving waterway is the delivery ratio. It is influenced by the magnitude of the sediment sources, the proximity of pollutant sources to the receiving water, and the velocity and volume of the water. Control strategies are available for types of nonpoint pollution: agriculture--terracing, diversions, grassed waterways, cover plants; silviculture--proper design of roads and transportation networks, buffer strips, chemical erosion control, diversions; construction--protection of slopes and easily eroded places, soil covers, stormwater deflection, site restoration after construction; surface mining--overburden segregation, site restoration with regrading and revegetation, proper design of roads and transportation networks; subsurface mining--restriction of water flow, maintenance of an anaerobic atmosphere, proper mine site selection, plugging of boreholes, grouting; urban stormwater runoff--street cleaning,

catch basin cleaning, detention basins, treatment. (See also W88-00314) (Cassar-PTT)
W88-00336

HAZARDOUS WASTE,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
IN: Environmental Pollution and Control, 2nd edition. Butterworth, Boston, MA. 1983. p 191-207, 2 fig.

Descriptors: *Water pollution sources, *Water quality control, *Landfills, *Industrial wastes, *Waste management, Chemical wastes, Water pollution control.

Of the 60 million metric tons of hazardous waste generated each year in the U.S., most is inadequately disposed of in humid areas where aquifers used for drinking water may be easily contaminated. Some techniques for reducing the pollution potential of the wastes are chemical stabilization/fixation, volume reduction, waste segregation, detoxification, degradation, and encapsulation. Proper transportation can minimize spills and pollution of streams or water supplies. Reuse of hazardous wastes in another industry reduces the quantity of potential pollutants. Proper landfill design, operation, and site closure are necessary to prevent or minimize seepage into groundwater. (See also W88-00314) (Cassar-PTT)
W88-00338

WATER QUALITY TRENDS IN THE LAS VEGAS WASH WETLANDS,
Nevada Univ., Las Vegas. Lake Mead Limnological Research Center.
F. A. Morris, and L. J. Paulson.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 125-136, 8 fig, 1 tab, 10 ref.

Descriptors: *Fate of pollutants, *Nitrogen, *Phosphorus, *Wastewater disposal, Land disposal, Las Vegas Wash, Ammonia, Wetlands, Absorption, Lake Mead.

Nutrient transport through the Las Vegas Wash was studied for 18 months starting in July 1979. Secondary wastewater effluent is discharged into the Wash, from which it enters Lake Mead. The mean loading rates (in kg/day) measured 1.6 km from the lake were: total nitrogen, 3172; total phosphorus, 539.6. Mean removal rates (kg/day) were: total nitrogen, 1001.1; total phosphorus, 156.9. Efficiency of removal decreased with increasing velocities and volumes of flows. (See also W86-02484) (Cassar-PTT)
W88-00345

NATURE AND AVAILABILITY OF PARTICULATE PHOSPHORUS TO ALGAE IN THE COLORADO RIVER,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
R. J. Watts, and V. A. Lamarra.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 161-180, 4 fig, 9 tab, 26 ref.

Descriptors: *Rivers, *Phosphorus, *Algae, Colorado River, Nutrients, Primary productivity, Productivity, Suspended sediments, Sediments.

Nutrient levels were determined in the Colorado River above Lake Powell during July-October 1978--phosphate-P, <10 micrograms/L; filterable P, 15-30 micrograms/L; acid hydrolyzable phosphorus, 6-13 micrograms/L; total phosphorus, 81-105 micrograms/L; nitrate-N, 688-1394 micrograms/L; nitrite-N, 6-21 micrograms/L; ammonia-N, 34-44 micrograms/L; temperature, 11-25 C; pH, 8.1-8.4; and Secchi disc transparency, 44-85 cm. Net primary production was estimated at 501 g C/sq m/hr in August, and 12.6-69.6 g C/sq m/hr in the other months of the study. Although orthophosphate levels were below 10 micrograms/L, planktonic primary production was high if turbidity was low. Phosphorus associated with calcite was found to be a source for algal growth. (See also W86-02484) (Cassar-PTT)
W88-00347

POTENTIAL EFFECTS OF PROCESSED OIL SHALE LEACHATE IN THE AQUATIC ENVIRONMENT,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5C.
W88-00354

POTENTIAL IMPACTS OF ENERGY DEVELOPMENT UPON WATER QUALITY OF LAKE POWELL AND THE UPPER COLORADO RIVER,
Colorado Univ., Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
A. J. Medine.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 399-424, 2 fig, 13 tab, 24 ref.

Descriptors: *Water pollution sources, *Environmental effects, *Energy, *Oil shale, *Rivers, *Mine wastes, *Metals, *Water quality, Lake Powell, Colorado River, Green River formation, Leachates, Heavy metals, Wastewater, Fate of pollutants.

Questions concerning the impact of oil shale production on water quality and the environment are discussed considering four major scenarios (4 million to 0.4 million barrels/day). Heavy metals in the sediments and water of tributaries in the Colorado River system and in Lake Powell are high enough to warrant further study. Potential water quality impacts of oil shale production are hard to quantify. However, concerns are listed. Growing populations in the mining areas would also contribute industrial and municipal wastewater discharges, significantly increasing the productivity of Lake Powell. A sound monitoring program is vital for studying the fate and effects of pollutants in this system. (See also W86-02484) (Cassar-PTT)
W88-00357

EROSION AND SALINITY PROBLEMS IN ARID REGIONS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French, and W. W. Woessner.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 425-437, 3 fig, 1 tab, 15 ref. Contract Nos. 0-07-30-V0126 and YA-512-CT-200.

Descriptors: *Fate of pollutants, *Water pollution sources, *Saline soils, *Erosion, Las Vegas Valley, Soil erosion, Floods, Flash floods, Colorado River, Rivers, Arid lands.

Studies of soil samples collected at 78 sites in s 39 sq km area of the Lower Las Vegas Valley indicated that erosion contributes to the salinity problem in the Colorado River system. Between the ground surface and 3 m depth 3.9 million Mg (33.7 kg/cu m) of salt are stored. In the first 15 cm of soil the salt concentration is 51.4 kg/cu m. In some areas the salt level is greater than 802 kg/cu m of soil. The greatest amount of salt storage occurs in the 30-60 cm and 180-240 cm intervals. Between August 1975 and April 1979 about 450,000 cu m (777,000 Mg) of soil was eroded from the Las Vegas Valley. Examination of the headcut showed an erosion rate of 364 cu m (628 Mg) of soil/day. Thus erosion in the Lower Las Vegas Wash may contribute 4000 kg of salt on an annual basis to the Colorado River. Depending on where the sediment is being eroded, between 2% to 10% of the total salinity entering the river from the wash is attributable to erosion. The July 1975 flash flood removed 63,000 Mg of soil and 1270-6280 Mg of salt. (See also W86-02484) (Cassar-PTT)
W88-00358

CHEMISTRY OF PARTICLES.
Acid Precipitation Series, Volume 2, Butterworth Publishers, Boston, 1984. Volume edited by Jack L. Durham. Series edited by John I. Teasley. 262 p.

Descriptors: *Fate of pollutants, *Acid rain, *Precipitation, *Oxidation, *Aerosols, Sulfuric acid, Sulfur dioxide, Nitric acid, Sulfates, Nitrates, Chemical reactions, Fog, Clouds, Ozone, Hydrogen peroxide.

Recent advances in the theoretical, experimental laboratory, and field investigations of processes leading to acidification of particles, fogs, and rain are presented. The role of oxidation in acid precipitation is emphasized. Sulfur dioxide, nitric acid, hydrogen peroxide, and ozone have highly interactive roles in acidification. Papers concern thermodynamics, use of oxygen-18 isotopes to study formation and neutralization of acidic aerosols, sulfur dioxide and nitrogen dioxide reactions in haze and cloud, acid particles and droplets in the atmosphere, oxidation of dissolved sulfur dioxide and adsorption of nitric acid to produce acidification, and solubility of atmospheric particulate matter (e.g., metals, ammonium salts, nitrates, and sulfates). (See W89-00372 thru W88-00377) (Cassar-PTT)
W88-00371

THERMODYNAMIC EQUILIBRIUM PROPERTIES OF AQUEOUS SOLUTIONS OF NITRATE, SULFATE AND AMMONIUM,
Exxon Research and Engineering Co., Florham Park, NJ.
A. W. Stelson, M. E. Bassett, and J. H. Seinfeld.
IN: Acid Precipitation Series, Volume 2: Chemistry of Particles, Fogs and Rain, Butterworth Publishers, Boston. 1984. Volume edited by Jack L. Durham. Series edited by John I. Teasley. p 1-52, 14 fig, 9 tab. 60 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Precipitation, Thermodynamics, Ammonium sulfate, Nitric acid, Sulfuric acid, Chemical reactions, Equilibrium, Vapor pressure, Nitrates, Sulfates, Ammonium nitrate.

The thermodynamic properties of three aqueous systems have been considered in detail: (1) ammonium nitrate/nitric acid/water (2) ammonium nitrate/ammonium sulfate/water, and (3) ammonium sulfate/sulfuric acid/water. The theory and techniques presented in this chapter enable one to calculate the vapor pressure and thermodynamic properties of any aqueous system of nitrate, sulfate, ammonium, nitric and sulfuric acids. For example, all the activity coefficients required to study the full ammonium nitrate/nitric acid/ammonium sulfate/sulfuric acid/water system are now known. In addition, techniques for estimating the temperature dependence can be applied to the other systems considered here. (See also W88-00371) (Cassar-PTT)
W88-00372

ACIDIC AEROSOLS: OXYGEN-18 STUDIES OF FORMATION AND INFRARED STUDIES OF OCCURRENCE AND NEUTRALIZATION,
Argonne National Lab., IL. Chemical Technology Div.
P. T. Cunningham, B. D. Holt, S. A. Johnson, D. L. Drapcho, and R. Kumar.
IN: Acid Precipitation Series, Volume 2: Chemistry of Particles, Fogs and Rain, Butterworth Publishers, Boston. 1984. Volume edited by Jack L. Durham. Series edited by John I. Teasley. p 53-

130, 36 fig, 4 tab, 163 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Precipitation, *Aerosols, Nitric acid, Sulfuric acid, Nitrates, Sulfates, Isotope studies, Oxygen isotopes, Neutralization, Chemical reactions, Variability, Seasonal variability, Diurnal variation, Urban areas, Oxidation.

Oxygen isotopy proved applicable to the study of mechanisms of sulfate formation since the isotope of the sulfates was easily differentiated depending on the formation process, such as aqueous-phase hydrogen peroxide oxidation, surface oxidation, homogeneous gas-phase oxidation, and high-temperature air oxidation. Aerosol samples collected in and near urban areas (Chicago, Illinois; St. Louis, Missouri) varied with time, changing from neutral to acidic and back to neutral within a few hours, showing the influence of locally variable sources and inhomogeneity of the atmosphere. Aerosol samples collected at five sites in the Northeast were highly acidic. These showed monthly, seasonal, diurnal, and daily variations. Aerosol mass loadings were highest during summer. Aerosol acidity was high in summer and winter, low in spring and fall. Acidity was highest in the late morning-early afternoon, lowest during the night. The diurnal variation is explained by convective mixing, which brings acidic aerosol to the ground in daytime where it is neutralized by ammonia at the ground level during the night. No evidence was found of sulfate acidity coexisting with nitrate ion, indicating that sulfuric acid displaces nitric acid from the condensed phase to the gas phase whenever the two are present in the same air mass. Aerosol aloft was often acidic while simultaneous ground-based samples were neutral, indicating that the atmosphere is more acidic than ground measurements suggest. (See also W88-00371) (Cassar-PTT)
W88-00373

STUDIES OF SULFUR DIOXIDE AND NITROGEN REACTIONS IN HAZE AND CLOUD,
Nevada Univ. System, Reno. Desert Research Inst.
A. W. Gertler, D. F. Miller, D. Lamb, and U. Katz.
IN: Acid Precipitation Series, Volume 2: Chemistry of Particles, Fogs and Rain, Butterworth Publishers, Boston. 1984. Volume edited by Jack L. Durham. Series edited by John I. Teasley. p 131-160, 9 fig, 5 tab, 62 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Precipitation, *Aerosols, Nitric acid, Sulfuric acid, Nitrates, Sulfates, Chemical reactions, Oxidation, Clouds, Haze, Sulfur dioxide, Catalysts, Hydrogen ion concentration, Ozone, Hydrogen peroxide, Sodium chloride.

Cloud chamber studies showed that no significant rate of sulfur dioxide oxidation was observed in haze (dry particle diameters of about 0.1 micron) experiments up to 95% relative humidity. However, on the much larger scale in the atmosphere other surface-dependent reactions and gas mixtures may occur often enough to provide a significant sink of atmospheric sulfur dioxide, even at low rates. For cloud droplets produced from cloud condensation nuclei (CCN) of 0.1 micron in diameter, the aerobic sulfur dioxide conversion rates were small and independent of CCN composition. Average conversion rate was 0.6%/hr with a final pH of 4.7 and a sulfur dioxide lifetime of about 170 hours. When larger, intentionally buffered CCN (0.5-0.9 micron dry diameter) were used, a distinct dependence of sulfur dioxide conversion rate on pH emerged. The first-order rate constant was 0.0001-0.001/sec. Mn(++) ion (0.001M) proved to be an effective catalyst for sulfur dioxide oxidation, especially at pH 4. Elevated sulfur dioxide oxidation rates were also observed in clouds made from sodium chloride nuclei (0.5 micron dry diameter). Clouds produced in air containing nitrogen dioxide had very small concentrations of nitrate. However, nitrate concentrations were substantial when clouds were produced in air with nitrogen dioxide and ozone or hydrogen peroxide. Nitrogen dioxide to nitrate conversion rates approaching 10%/hr were observed. (See also W88-00371) (Cassar-PTT)
W88-00374

OBSERVATIONS ON ACID PARTICLES AND DROPLETS IN THE ATMOSPHERE,
Deutscher Wetterdienst, Hamburg (Germany, F.R.). Meteorologisches Observatorium.
P. Winkler.
IN: Acid Precipitation Series, Volume 2: Chemistry of Particles, Fogs and Rain, Butterworth Publishers, Boston. 1984. Volume edited by Jack L. Durham. Series edited by John I. Teasley. p 161-196, 18 fig, 1 tab, 64 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Precipitation, *Aerosols, Neutralization, Chemical reactions, Ammonia, Oxidation, Hydrogen ion concentration, Conductivity, Fog, Clouds.

Simultaneous measurements of pH and conductivity turn out to be an important tool for characterization of the acidity content of aerosol and precipitation. The acid fraction of the soluble matter of the aerosol is of the order of a few percent. The acid fraction increases with decreasing particle radius and increases with increasing total pollution. In marine air the acidity is concentrated in particles with radii below 0.3 micron, and the acid fractions are usually higher than over the continents or in cities. Most probably, lack of ammonia is the reason for the high acidity of the small marine particles. The larger marine particles are neutral or alkaline, depending on the sea salt contribution. The acid fraction of the precipitation is usually much higher than that of aerosols; therefore, aerosol scavenging is not sufficient to explain precipitation acidity. The acid fraction shows a characteristic dependence on the pH values. A characteristic relation between pH and conductivity is derived that is rather independent of the measuring location. At pH values <4.5-4.2, the trace substance content of the precipitation is dominated by free acid. Due to the limited lifetime of cloud and raindrops and due to limited mass transport and chemical oxidation rates a lower pH limit around 3.4 seems to exist. Because single precipitation events therefore cannot produce an unlimited high acid content in the precipitation, the consequences of a further increase of acidifying emissions is to spread out the acid rain areas. The lack of a pH trend of the precipitation during the last 50 years in Central Europe and the decrease of pH values in the Scandanavian countries confirm this hypothesis. (Author's abstract)
W88-00375

ACIDIFICATION OF RAIN BY OXIDATION OF DISSOLVED SULFUR DIOXIDE AND ADSORPTION OF NITRIC ACID,
Environmental Protection Agency, Research Triangle Park, NC.
J. L. Durham, H. M. Barnes, and J. H. Overton.
IN: Acid Precipitation Series, Volume 2: Chemistry of Particles, Fogs and Rain, Butterworth Publishers, Boston. 1984. Volume edited by Jack L. Durham. Series edited by John I. Teasley. p 197-235, 22 fig, 7 tab, 35 ref, append.

Descriptors: *Fate of pollutants, *Acid rain, *Precipitation, Oxidation, Sulfur dioxide, Nitric acid, Chemical reactions, Rain, Model studies, Ozone, Sulfuric acid, Hydrogen peroxide, Ammonia, Sulfates, Nitrates, Clouds.

Simulations using the subcloud scavenging/chemical reaction model led to several conclusions. (1) Hydrogen peroxide oxidizes dissolved sulfur dioxide more effectively than did ozone, Mn(++), and C(O). (2) The rate of acidification is nonlinear with respect to the concentration of sulfur dioxide when the concentration of sulfur dioxide is greater than the concentration of hydrogen peroxide. Reducing the sulfur dioxide concentration does not reduce the rate or quantity of sulfuric acid formed, as long as the concentration of sulfur dioxide is greater than the concentration of hydrogen peroxide. If the concentration of sulfur dioxide is less than the concentration of hydrogen peroxide, reducing sulfur dioxide concentration proportionally reduces the sulfuric acid in the rain. Nitric acid inhibits the effectiveness of ozone for oxidizing dissolved sulfur dioxide. The effectiveness of hydrogen peroxide for oxidizing sulfur dioxide is not inhibited at pH 2-6. Nitric acid is rapidly scavenged by initial rainfall, producing lower pH at the beginning of a rain. Hydrogen peroxide is also rapidly scavenged and may react in the sample collector to produce more acid. (See also W88-00371) (Cassar-PTT)
W88-00376

SOLUBILITY OF ATMOSPHERIC PARTICULATE MATTER,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
M. E. Perry, A. W. Elzerman, and T. J. Overcamp.
IN: Acid Precipitation Series, Volume 2: Chemistry of Particles, Fogs and Rain, Butterworth Publishers, Boston. 1984. Volume edited by Jack L. Durham. Series edited by John I. Teasley. p 237-257, 3 fig, 6 tab, 76 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Precipitation, *Particulate matter, Nitrates, Chemical reactions, Rain, Ammonia, Sulfates, Solubility, Lakes, Metals, Heavy metals, Lead, Calcium, Aerosols.

The fate and distribution of acidity and related ions solubilized from atmospheric aerosols entering an aqueous system will be determined by the rate of their release to solution. Over 80% of the soluble acidity, sulfate, nitrate and ammonium was released to distrilled, deionized water in less than 30 sec, and solubilization was essentially complete in less than 60 sec for the samples discussed above. Similar results have been obtained for other samples and components. Based on these observations, the fate of the soluble component of atmospheric particulate inputs to aqeuous systems will be controlled, at least initially, by solution-phase processes. In most cases, release of the major soluble components will effectively be immediate on contact with water in lakes, rain, fog, respiratory systems, sampling devices or moist areas of construction materials. For example, physical transport of solid atmospheric particles in their original form in raindrops, or from the surface microlayer of a lake to the bulk water below, will be of little consequence with respect to strong acidity, sulfate, nitrate and ammonium, or even some minor, but significant, components like lead. Since the soluble fraction contains significant components in relation to inputs of acidity, nutrients and potentially toxic materials, rapid release to solution will be important to understanding their fate and effects. (See also W88-00371) (Author's abstract)
W88-00377

ECOLOGICAL STUDY OF THE AMOCO CADIZ OIL SPILL.
National Oceanic and Atmospheric Administration, Washington, DC.
For primary bibliographic entry see Field 5C.
W88-00378

MICROBIAL HYDROCARBON DEGRADATION WITHIN SEDIMENT IMPACTED BY THE AMOCO CADIZ OIL SPILL,
Louisville Univ., KY. Dept. of Biology.
R. M. Atlas.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p 1-25, 9 fig, 21 tab.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Marine sediments, *Microbial degradation, *Oil spills, Path of pollutants, Sediments, Petroleum products, Oil, Organic compounds, Biodegradation, Oil characterization, Oil pollution.

Microbial degradation played a very important role in the weathering of oil spilled from the AMOCO CADIZ. The chemical evolution of the hydrocarbon mixture within intertidal sediments led to a relative enrichment in isoprenoid alkanes, a transient complex unresolved mixture, and a relative enrichment of dibenzothiophenes and alkylated phenanthrenes. The concentrations of hydrocarbons generally declined at sites that were regularly covered by tides. Cleansed sites showed little

chemical or microbial evidence of impact from the oil spill. The incurrence of oil from the TANIO wreck was apparent even at sites that had been oiled during the AMOCO CADIZ spill. The microbial population levels generally reflected the relative degrees of persistence of petroleum hydrocarbons. The indigenous microbial community retained the capability of responding to a second incursion of oil resulting from the TANIO spill. Both field and in vitrostudies suggest that mixing energy, related to nutrient and oxygen availability, was extremely important in permitting the high rates of observed oil weathering. The occurrence of both saturated and unsaturated acids in the sediments studied in vitro suggest that several biochemical pathways were active in the biodegradation of the aliphatic hydrocarbon fraction. (See also W88-00363) (Geiger-PTT)
W88-00379

LABORATORY SIMULATION OF THE MICROBIOLOGICAL DEGRADATION OF CRUDE OIL IN A MARINE ENVIRONMENT,
Institut Francais du Petrole, Rueil-Malmaison.
D. Ballerini, J. Ducreus, and J. Riviere.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p 27-34, 1 fig.

Descriptors: *Biodegradation, *Pollutant identification, *Oil, *Petroleum products, *Fate of pollutants, Hydrocarbons, Organic compounds, Gas chromatography, Oil spills, Microbial degradation, Culturing techjniques, Toxicity, Waste-assimilative capacity.

Experiments were conducted in batch and continuous culture laboratory reactors to quantify the biodegradation process of a crude oil (Arabian Light Crude) in optimum conditions compatible with the marine environment. Hydrocarbons produced during biodegradation were analyzed by infrared spectrometry and gas chromatography. CO2 production was determined by titrimetry. Liquid samples taken during fermentation were analyzed for total organic carbon, dissolved CO2, residual P, residual ammonical N, and intracellular N. Results of batch culture biodegradation experiments showed that the saturated hydrocarbons are the most rapidly biodegraded. The disappearance of aromatic compounds is accompanied by an enrichment of the aqueous phase in organic carbon. The resins are only slightly attacked and the asphatenes are not biodegraded at all. The isoprenmoids and the n-alkanes disappeared almost totally by the end of the culture. With respect to the aromatics fraction, the action of microorganisms mainly affected the mono- and di-aromatic compounds. Changes were observed in the microbial flora as the crude oil was biodegraded. No myutagenic activity was observed in two samples of oxidation products. Results of biodegradation studies of a mixture of pure hydrocarbons confirm results found with Arabian Light Crude. The limiting concentrations of N, P, and O for the biodegradation process were checked in continuous cultures. (See also W88-00363) (Geiger-PTT)
W88-00380

AMOCO CADIZ ANALYTICAL CHEMISTRY PROGRAM,
Energy Resources Co., Inc., Cambridge, MA.
P. D. Boehm.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p 35-99, 82 fig, 29 tab, 20 ref.

Descriptors: *Fate of pollutants, *Pollutant identification, *Oil spills, *Biodegradation, *Marine sediments, Oysters, Mollusks, Fish, Gas chromatography, Mass spectrophotometry, Petroleum products, Hydrocarbons, Organic compounds, Microbial degradation, Oil, Path of pollutants, Bottom sediments, Ecological effects, Environmental effects.

As part of the NOAA/CNEXO research program to examine the long-term fates and effects of the AMOCO CADIZ oil spill, samples of frozen intertidal surface sediment, sediment cores, oysters, flatfish and macroalgae were examined by gas chromatography and mass spectrophotometry to study the weathering of AMOCO CADIZ oil, persistence of marker compounds, residues in tissues and environmental variability of oil pollution. Results showed that oil was weathered rapidly by biodegradation and evaporation. Oil was buried in most sedimentary environments with burial and/or penetration down to 15 cm in fine-grained sediments and 20-30 cm in sandy sediments. Offshore sediments were impacted after the shoreline impact through beaching, sorption on intertidal sediments and offshore transport of these sediments. The presence of unresolved material, pentacyclic triterpanes, and alkylated phenanthrene and dibenzothiophene compounds is characteristic of AMOCO CADIZ oil in sediments. Identifiable AMOCO CADIZ oil residues still persist at the Ile Grande marsh. Oysters were initally heavily impacted by the spill and contained residues of AMOCO CADIZ oil even after 2 yr. Fish do not appear to have been directly impacted chemically by the oil spill to any significant exctent. Compositional profiles traceable to AMOCO CADIZ oil are likely to disappear from all sediments by the fourth year after the spill. (See also W88-00363) (Geiger-PTT)
W88-00381

STUDIES OF HYDROCARBON CONCENTRATIONS AT THE ILE GRANDE AND BAOE DE LANNION STATIONS POLLUTED BY THE WRECK OF THE AMOCO CADIZ,
Centre National de la Recherche Scientifique, Marseille (France). Lab. de Chemie Organique.
For primary bibliographic entry see Field 5A.
W88-00382

EVOLUTION OF THE HYDROCARBONS PRESENT IN THE SEDIMENTS OF THE ABER WRAC'H ESTUARY,
Institut Francais du Petrole, Rueil-Malmaison.
J. Ducreux.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p 111-142, 26 fig, 10 tab, 11 ref.

Descriptors: *Biodegradation, *Hydrocarbons, *Marine sediments, *Fate of pollutants, *Oil pollution, Degradation, Sediments, Pollutant identification, Organic compounds, Oil spills, Oily water, Beaches, Petroleum products, Estuaries.

The physico-chemical evolution of the hydrocarbons present in the sediments of the Aber Wrac'h estuary was studied in the subtidal sediments, water surface-stable emulsions (chocolate mousse), and the intertidal sediments. The pollutant was identified as a mixture of Iranian light crude and Arabian light crude. In the slightly muddy sediments of fine sand in the outer part of the Aber Wrac'h, a decrease in global contents of extractable compounds is observed, whereas in the upper part of the Aber, the decontamination process is slow. The degradations of hydrocarbons resulted in the progresive dissapearance od saturated hydrocarbons and light aromatic hydrocarbons, and the oxidation of polar compounds. The saturated polycyclic hydrocarbons, heavy aromatics, sulfurous aromatic hydrocarbons of the thiophenic type, and resins and asphaltenes persisted. In the sediment samples in the area of the Aber, terrigenic deposits are superposed on the AMOCO CADIZ crude resulting in an increase in polar compounds and the appearance of n-alkanes of odd carbon numbers (n-C25 through n-C33). The most noticeable change in the chocolate mousse samples is the loss of light hydrocarbons due to evaporation and dissolution. Samples of polluted sand taken from the beaches a year after the spill show degradation mainly of the saturated hydrocarbons, principally the n-paraffins. (See also W88-00363) (Geiger-PTT)
W88-00383

AMOCO CADIZ OIL SPILL: DISTRIBUTION AND EVOLUTION OF OIL POLLUTION IN MARINE SEDIMENTS,
Centre Oceanologique de Bretagne, Brest (France).
M. Marchand, G. Bodennec, J. C. Caprais, and P. Pignet.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p143-157, 10 fig, 9 tab, 9 ref.

Descriptors: *Oil spills, *Fate of pollutants, *Oil pollution, *Marine sediments, *Degradation, Oil, Path of pollutants, Bays, Estuaries, Sediments, Decontamination, Coasts, Shores, Spatial distribution.

Surface marine sediments were collected in the western English Channel with a Shipek grab, and in coastal areas, with small Ekman and Hamon grabs to study the distribution and evolution of oil pollution in marine sediments following the oil spill of the AMOCO CADIZ. A specific study was also made of the oil evolution in the Aber Wrac'h from 1978 to 1981. The highest petroleum accumulation in marine sediments was located in the Bays of Morlaix and Lannion and in the coastal and sheltered zone of the Abers. Three sedimentary oil accumulation areas were recognized in the Bay of Morlaix: the Morlaix River, the Penze River, and the east area of the bay around Primel. Hydrocarbon analyses of deep layers in the sediment cores did not reveal any significant vertical penetration of oil. Three zones of Aber Wrac'h were estimated in terms of oil degradation: the mouth of the estuary, the downstream part, anf the upstream part. The decontamination process in the Aber Wrac'h is mainly related to the energy level of the zone. The mouth of the Aber after 3 years is well decontaminated. However, sediments within Aber Wrac'h remain quite polluted with about 20% of the residual oil content still remaining in March 1978. (See also W88-00363) (Geiger-PTT)
W88-00384

AMOCO CADIZ POLLUTANTS IN ANAEROBIC SEDIMENTS: FATE AND EFFECTS ON ANAEROBIC PROCESSES,
Montana State Univ., Bozeman. Dept. of Microbiology.
D. M. Ward, M. R. Winfrey, E. Beck, and P. Boehm.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p 159-190, 10 fig, 10 tab, 45 ref.

Descriptors: *Marine sediments, *Fate of pollutants, *Oil pollution, *Water pollution effects, *Anaerobic processes, Microbial degradation, Biodegradation, Hydrocarbons, Sediments, Methane, Sulfates, Carbon dioxide, Beaches, Estuaries, Marshes, Oil, Petroleum products, Ecological effects, Environmental effects, Oil spills.

Terminal processes of the anaerobic food chain were examined in sediments oiled by the AMOCO spill. Sediment cores of beach, estuary, and salt marsh sites were analyzed for microbial activity (sulfate reduction, methane production, acetate metabolism, hydrocarbon metabolism, and gas production), oil chemistry, and sediment chemistry. Rates of sulfate reduction were highest in the surface layer and decreased with depth in all sites. Rates in the 0-3 cm intervals were higher in oiled compared to control Aber mudflat sediments. In the beach and salt marsh musflat sediments, rates were higher in control sites than in oiled sites. This difference may be caused by differences between sampling sites and organic loading, and is not solely attributable to AMOCO CADIZ oil. To more directly observe the effect of oiling on microbial activities in sediments, AMOCO CADIZ mousse was added to Ile Grande sediments, and activities were compared between mousse-treated and untreated sediments. An extensive weathering of low molecular weight compounds in the mousse occurred before collection. A slight inhibition of sulfate reduction rate was observed at the control site, while a slight stimulation was noted at the oiled site. No significant difference in methane production between control and mousse-treated sediments was observed. CO2 production was significantly reduced at oiled sites; the inhibition decreased with the amount of weathering of the oil. (See also W88-00363) (Geiger-PTT)
W88-00385

LONG-TERM IMPACT OF THE AMOCO CADIZ CRUDE OIL SPILL ON OYSTERS CRASSOSTREA GIGAS AND PLAICE PLEURONECTES PLATESSA FROM ABER BENOIT AND ABER WRAC'H, BRITTANY, FRANCE,

Battelle New England Marine Research Lab., Duxbury, MA.
For primary bibliographic entry see Field 5C.
W88-00386

GROUND WATER 82: PROGRAMME AND EXTENDED ABSTRACTS.
Geological Society of South Africa, Johannesburg. Ground Water Div.
For primary bibliographic entry see Field 2F.
W88-00388

USE OF RESISTIVITY METHODS TO EVALUATE GROUND WATER POLLUTION IN SOUTH AFRICA,
J. N. Faurie.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 72-77, 5 fig.

Descriptors: *Path of pollutants, *Resistivity, South Africa, Plumes.

A surface resistivity survey was conducted below the wall of a waste disposal dam to evaluate the role of the resistivity method in locating and defining the plume of contaminated groundwater. Sixteen boreholes, drilled previously for monitoring, were used to determine water quality. Low resistivities were correlated with extremely high total dissolved solids and calcium concentrations (40 ohm.m compared with 1610 ppm total dissolved solids); conversely, higher resistivities were found where water was relatively free of impurities (130 ohm.m compared with 45 ppm total dissolved solids). (See also W88-00373) (Cassar-PTT)
W88-00395

HYDROLOGICAL DISTURBANCES ASSOCIATED WITH INCREASED UNDERGROUND EXTRACTION OF COAL,
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
F. D. I. Hodgson.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 178-186, 19 ref.

Descriptors: *Water pollution sources, *Groundwater movement, *Coal mining, Acid mine drainage, Mine wastes, Industrial wastes, Water table fluctuations, Rock mechanics, Recharge, Runoff, Subsidence, Groundwater pollution, Sulfuric acid.

A review of literature on the effects of increased extraction of coal on the underground environment considered groundwater disturbances, surface disruptions, and groundwater pollution. Among the groundwater disturbances are (1) fracture of impermeable layers with resulting sudden and long-term drop in the water table, (2) cracking of overlying rocks, increasing permeability and draining groundwater into caverns where it may be contaminated, (3) degradation of water quality in boreholes, and (4) capture of rainfall recharge. On the surface, cracks and subsidence can increase rain infiltration in certain areas, depriving downstream areas of water for infiltration. Sediments are the main source of short-term pollution. These release a variety of pollutants such as sodium, potassium, chloride, and sulfate, while decreasing bivalent cations such as calcium and magnesium. The most serious long-term pollutant is sulfuric acid, formed by oxidation of pyrite. When mining operations cease, acid drainage would decrease if the mines are flooded. However, adjacent groundwater, springs, and rivers would tend to become polluted. (See also W88-00373) (Cassar-PTT)
W88-00402

FINITE ELEMENT MODELLING OF TWO-DIMENSIONAL SOLUTE TRANSPORT IN GROUNDWATER,
A. C. S. Smith, J. A. C. Diering, and J. B. Shopley.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 224-231, 4 fig, 8 ref.

Descriptors: *Fate of pollutants, *Solute transport, *Landfills, Groundwater pollution, Model studies, Mathematical models, South Africa, Waste disposal, Strip mines, Water quality.

QSOL, a two-dimensional solute transport model, was applied to the problem of groundwater pollution resulting from the restoration of a planned open-pit strip mine to its natural ground level. Waste materials would be backfilled into the pit. The model clearly showed that there was no potential for contaminating the nearby river. Groundwater in the region was significantly affected by the proposed disposal plan. (See also W88-00373) (Cassar-PTT)
W88-00405

LEVELS OF POLYCHLORINATED BIPHENYLS IN THE FORT EDWARD, NEW YORK, WATER SYSTEM,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 5A.
W88-00426

INDUSTRIAL ORGANIC COMPOUNDS IN THE NIAGARA RIVER WATERSHED,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 5A.
W88-00427

CHARACTERIZATION OF ORGANIC MATERIALS AT WATER FACTORY 21,
Stanford Univ., CA. Dept. of Civil Engineering.
M. Reinhard, and P. L. McCarty.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 33-53, 7 fig, 7 tab, 19 ref.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Organic compounds, Wastewater renovation, Advanced wastewater treatment, Trace levels, Chlorinated hydrocarbons, Aromatic hydrocarbons, Phthalates, Chlorination, Pollutant identification.

More than 100 specific compounds have been identified partially or fully by gas chromatography/mass spectrometry in influent and/or effluent from an advanced wastewater treatment facility in Orange County, California. The plant treats 0.66 cu m water/sec at design flow with lime treatment, ammonia stripping, recarbonation, filtration, activated carbon contacting, and, for one-third of the flow, reverse osmosis. Chlorine added in the recarbonation basin for algae control and in the final chlorination basin for disinfection and ammonia removal. The treatment process removes those compounds classed as volatile and hydrophobic to concentration levels of 20 ng/L or less. Chlorination in the recarbonation and final chlorination basins increases the levels of haloforms, halogenated ketones and, to a very small degree, those of some chlorinated aromatics. Most of the volatile and hydrophobic compounds in the effluent contained chlorine. Efficiency of the treatment plant was higher when water of lower quality was processed. (See also W88-00434) (Cassar-PTT)
W88-00437

TRACE ORGANIC SUBSTANCES IN THE RIVER LEE,
Water Research Centre, Stevenage (England).
A. Waggott.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 55-99, 20 fig, 7 tab, 15 ref.

Descriptors: *Fate of pollutants, *Pollutant identification, *Organic compounds, Lee River, United Kingdom, Trace levels, Liquid/liquid extraction, Headspace analysis, Freeze drying, Liquid/solid extraction, Distillation, Resins, Chromatography, Mass spectrometry, Solvents, Chlorinated hydrocarbons, Surfactants, Pesticides, Phthalates, Solvents, Aromatic hydrocarbons, Rivers.

A variety of analytical techniques were used to study the trace organic compounds in the River Lee, which supplies water to North London. Methods included liquid/liquid extraction, headspace analysis, freeze drying, liquid/solid extraction, distillation, XAD resin concentration, organic extract concentration, derivatization techniques, gas-liquid chromatography, high performance liquid chromatography, and gas chromatography/mass spectrometry (GC/MS). Liquid chromatography had many difficulties. GC/MS was a very powerful technique. Over 150 compounds were identified in River Lee water. However, very few (long-chain fatty acid amides, butanoic acid, dichlorobenzyl methyl ether, cholesterol, coprostanol, several plasticizers, toluene, xylene, benzaldehyde, hexanol, tetrachloroethylene, trichloroethylene, and several surfactants and their metabolites) were found at levels >0.1 micrograms/L. The river water was judged relatively clean in terms of volatile organic compounds in spite of containing a high proportion of sewage effluent. (See also W88-00434) (Cassar-PTT)
W88-00438

IDENTIFICATION OF THE PARTIAL OXIDATION PRODUCTS FROM OZONATION OF HYDRAZINE, MONOMETHYL HYDRAZINE AND UNSYMMETRICAL DIMETHYL HYDRAZINE,
Catalytic, Inc., Philadelphia, PA.
W. F. Cowen, R. A. Sierka, and J. A. Zirrolli.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 101-118, 8 fig, 5 tab, 20 ref. Project No. DTC-8-139.

Descriptors: *Fate of pollutants, *Water pollution effects, *Hydrazine, *Ozonation, Fuels, Wastewater treatment, Oxidation, Monomethyl hydrazine, Dimethyl hydrazine, Bioassays, Pollutant identification.

Ozonation products of wastewater containing hydrazine and hydrazine-related rocket fuels were characterized. Minor amounts of nitrate were produced from the ozonation of hydrazine, monomethyl hydrazine (MMH) and unsymmetrical dimethyl hydrazine (UDMH). This was probably a result of ammonia of nitrosamine oxidation. MMH ozonation produced methanol and several other peaks, probably formaldehyde, formic acid, and formaldehyde monomethylhydrazone. UDHM ozonation produced methanol, formaldehyde dimethylhydrazone, formaldehyde monomethylhydrazone, N-nitrosodimethylamine, dimethyl formamide, and tetramethyl tetrazene. Aquatic bioassay studies with fathead minnows showed LC50 values of 4.5, 1.22, and 0.35 mg/L for hydrazine, MMH, and UDMH, respectively. Studies with Daphnia showed EC50 of 0.1 to <10 mg/L. Since hydrazine and its compounds react with dissolved oxygen, LC50 or EC50 could be lower in actual practice. Concentrations of the ozonation products can probably be reduced further by continued ozonation. (See also W88-00434) (Cassar-PTT)
W88-00439

DETERMINATION OF ORGANICALLY COMBINED CHLORINE IN HIGH-MOLECULAR-WEIGHT AQUATIC ORGANICS,
Minnesota Univ., Minneapolis.
M. P. McCahill, L. E. Conroy, and W. J. Maier.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 119-126, 5 tab, 8 ref. Contract No. PFR-7915312.

Descriptors: *Fate of pollutants, *Water pollution sources, *Organic compounds, Chlorine compounds, Bromine compounds, Mississippi River, Rivers, Pollutant identification, Filtration, Ultrafiltration.

Low concentrations of high-molecular-weight organically combined chlorine and bromine were found in the Mississippi River water at three or four sites sampled. Organically combined halides were found only in the operationally defined >0.5K and >1K size fractions. The small amounts of organic material in the >10K and >100K size fractions made determination of total organic chlorine (TOCl) and total organic bromine (TOBr) impossible for these fractions without further preconcentration. Although TOCl and TOBr were found in relatively unpolluted waters, the source of these materials (anthropogenic or naturally occurring) is unknown. (See also W88-00434) (Author's abstract)

W88-00440

EXPERIMENTALLY OBSERVED ANOMALIES IN COMPETITIVE ADSORPTION AND REEXAMINATION OF SOME AVAILABLE MODELS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-00446

ADSORPTION OF BENZENE FROM WATER BY ACTIVATED CARBON,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5F.
W88-00448

ADSORPTION OF POLYCHLORINATED BIPHENYLS FROM WATER BY ACTIVATED CARBON,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
M. Pirbazari, and W. J. Weber.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 309-339, 24 fig, 4 tab, 47 ref. Contract No. R-804369.

Descriptors: *Fate of pollutants, *Water treatment, *Activated carbon, *Adsorption, *Polychlorinated biphenyls, Organic compounds, Chlorinated hydrocarbons, Equilibrium, Kinetics, Aroclors.

Adsorption-equilibrium studies of polychlorinated biphenyls (PCB) (Aroclor 1254 and Aroclor 1016) indicated that adsorption of PCB is partially irreversible. In dynamic desorption studies no PCB was released from the carbon absorber columns. This behavior led to the conclusion that adsorption of PCB carbon may be chemisorption. The carbon had a higher affinity for Aroclor 1016, which has a lower chlorine content than Aroclor 1254. With a load of 40 micrograms/L of Aroclor 1016, an empty bed contact time of 0.6 min, and a hydraulic loading of 225 L/sq m/min, the column was able to reduce the concentration below the detection limit of <0.05 micrograms/L for about 8 months. The single-solute version of the MADAM model did not satisfactorily simulate and predict completely mixed batch reactor adsorption rates for PCB. The number of isomers in each PCB mixture and the lack of information on the adsorption characters of each were responsible for this. (See also W88-00434) (Cassar-PTT)
W88-00449

REACTION OF OZONE WITH POLYAROMATICS IN WATER,
Technische Hogeschool Delft (Netherlands).
J. C. Kruithof, and P. M. Heertjes.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 429-443, 6 fig, 3 tab, 17 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Ozonation, *Organic compounds, *Aromatic compounds, Naphthalene, Phenanthrene, Biphenyl, Oxidation.

Ozonation of several polyaromatics produced hydroxyhydroperoxides, which reacted further to produce cyclization, elimination of hydrogen peroxide, or rearrangement. Ozonation of naphthalene resulted in 3,6-dihydroxy-4,5-benzo-1,2-dioxane, o-phthalaldehyde, o-phthalaldehydic acid, and o-phthalic acid. Ozonation of phenanthrene resulted in 4,5,6,7-dibenzo-1,2-dioxo-3,8-cyclooctanediol, 2,2 '-diphendialdehyde, 2,2'-diphendialdehydic acid, and 2,2'-diphendicarboxylic acid. Ozonation of biphenyl fomed phenylglyoxal, benzoic acid, and benzaldehyde. Exhaustive ozonation of the immediate products produced oxalic acid and carbon dioxide. In water treatment ozonation is not likely to be carried out exhaustively. Therefore, intermediate products may be present. These may be removed by coagulation. (See also W88-00434) (Cassar-PTT)
W88-00453

ADEQUACY OF DISINFECTION FOR CONTROL OF NEWLY RECOGNIZED WATERBORNE PATHOGENS,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5D.
W88-00475

EFFECTS FROM RESIDUAL AND NO. 2 FUEL OILS ON INTERTIDAL INFAUNA RECOVERY RATE.
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W88-00476

ALABAMA MARINE LAW PROGRAM.
Mississippi-Alabama Sea Grant Consortium, Ocean Springs, MS.
For primary bibliographic entry see Field 5C.
W88-00477

PHYSICS AND CHEMISTRY OF ACID PRECIPITATION,
SRI International, Menlo Park, CA.
J. Chamberlain, H. Foley, D. Hammer, G. MacDonald, and O. Rothaus.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-019597. Price codes: A09 in paper copy, A01 in microfiche. Technical Report JSR-81-25, November 1981. 186 p, 17 fig, 16 tab, 313 ref, 4 append.

Descriptors: *Water pollution sources, *Fate of pollutants, *Acid rain, *Precipitation chemistry, Sulfur oxides, Nitrogen oxides, Precipitation, Literature reviews, Model studies, Water chemistry, Path of pollutants.

A literature review of acid precipitation revealed the following findings. (1) The acidity of precipitation has increased in the eastern U.S. (most dramatically in the southeast) over the past three decades with respect to increased acidity in a given region and the geographical area with the pH less than 5.6. (2) Acidity has not discernibly increased at Hubbard Brook, New Hampshire, where acidity records have been maintained since 1964. Here the acidity averages pH 4.0, which is a natural lower limit. (3) Sulfur emissions in the midwest states have decreased by 17% over the past 15 years while acidity of precipitation has increased in the northeast. (4) Nitrogen oxide emissions in the east increased by 46% from 1960 to 1978 but at a lower rate from 1970 to 1978. Sulfur dioxide emissions increased by 22% from 1960 to 1970 and decreased by 10% from 1970 to 1978. (5) The absolute quantity of emissions has decreased in the northeast but the acidity of precipitation in this region has increased, suggesting long range transport of pollutants. (6) Nitrogen oxides are an essential precursor to formation of hydrogen peroxide and ozone. (7) Heterogeneous processes involving strong oxidants and droplets play a significant role in converting gaseous emissions to strong acids. (8) Catalytic conversion of sulfur and nitrogen oxides to strong acid is probably insignificant. (9) The usefulness of the current numerical models is questioned. (10) Acid precipitation shows a high degree of variability. (11) Although much information exists on field observations and laboratory studies, little exists on field experiments. (Cassar-PTT)
W88-00485

ARRANGEMENT FOR DAMMING WATER AND ALSO FOR DRAINING AWAY THE VOLUME OF WATER ABOVE A CERTAIN LEVEL IN VEGETATION-BEARING STRATUM,
For primary bibliographic entry see Field 8A.
W88-00500

SECOND INTERNATIONAL CONFERENCE ON GROUND WATER QUALITY RESEARCH, PROCEEDINGS.
Oklahoma State Univ., Stillwater. Univ. Center for Water Research.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-208930/AS. Price codes: A10 in paper copy, A01 in microfiche. A consortium of Oklahoma State University, Rice University and the University of Oklahoma. Edited by N. N. Durham and A. E. Redelfs. OSU University Printing Services, Stillwater, Oklahoma, (1986). 222 p.

Descriptors: *Groundwater movement, *Groundwater pollution, *Path of pollutants, *Solute transport, *Microbial degradation, *Sorption processes, Groundwater, Surface-Groundwater relations, Water pollution control, Water pollution effects, Water pollution sources, Pollutant identification, Biodegradation, Chemical transformation, Chemical reactions.

A collection of manuscripts presented at the Second International Conference on Ground Water Quality Research, held March 26-29, 1984, in Tulsa, Oklahoma, the Conference emphasized physical, chemical and biological processes that control the movement and fate of contaminants in the sub-surface. New and improved processes and methodologies were discussed and coordinated with biotic and abiotic molecular transformation processes. Transport processes and sorption procedures exhibited new concepts and philosophies. The Conference provided an opportunity for interaction among scientists from many nations. The data and research evaluations and discussions contributed to expanding the existing knowledge base, as well as providing a foundation from which future policy statements may be better formulated. The information presented in this proceeding should be meaningful to scientists presently involved in water quality research programs, as well as individuals in other disciplines who may be able to apply new techniques and methodologies to resolving many existing problems. (Redelfs-Univ. Ctr. Water Res.)
W88-00534

CHROMIUM VALENCY RESPONSE AND ENVIRONMENTAL FATE IN THREE-PHASE AQUATIC MICROCOSMS,
Connecticut Univ., Storrs. Inst. of Water Resources.
M. F. Conway.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197620/AS. Price codes: A05 in paper copy, A01 in microfiche. M.S. Thesis, 1984. 82 p, 13 fig, 8 tab, 48 ref, 2 append. Project No. OWRT A-087-CONN (2). Contract No. 14-34-0001-0107.

Descriptors: *Chromium, *River impoundment, *Adsorption, Aquatic environment, Microcosm model, Connecticut, Naugatuck River, Water quality control, Path of pollutants, Valency, Solubility, Fate of pollutants, Sediment transport.

Factors affecting the valency, solubility, transport and biogeochemical fate of chromium in an aquatic environment were investigated and assessed utilizing a physical model. Three phase, atmosphere-water-sediment, microcosms were utilized in a semi-continuous flow-through mode to model a river impoundment. Effects of varying chromium inputs on algal growth, sediment uptake rates, dissolved oxygen concentrations, chromium valency response and ultimate fate of chromium were monitored. A concurrent study, conducted in an impoundment of the Naugatuck River in Thomaston, Connecticut, allowed field evaluation of responses observed in the microcosm models. A significant reduction of highly toxic Cr(6+) to relatively nontoxic (Cr(3+), accompanied by a decrease in total chromium concentration was observed in the river impoundment and was verified in the microcosm study. The observed rate of Cr(6+) reduction was observed to correlate directly with concentrations of reduced species, i.e., NH(4+) and Fe(2+), and inversely with dissolved O2. In an anoxic, sediment dominated, reduced environment, chromium was readily reduced and removed from solution through a mechanism termed reductive adsorption. The observed results are significant in terms of the natural ability of the impoundment to decrease water column concentrations of chromium in the Naugatuck River. (Conway-Inst. Water Res.)

W88-00547

EFFECTS ON GROUNDWATER FROM SEEPAGE OF LIVESTOCK MANURE LAGOONS,
Clemson Univ., SC. Dept. of Agricultural Engineering.
R. O. Hegg, T. G. King, and T. V. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB81-115180. Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Report No. 78, Clemson Univ., SC, September 1979. 47 p, 19 fig, 3 tab, 11 ref, append. Dept. of Agricultural Engineering. Project No. OWRT B-091-SC (1). Contract No. 14-34-0001-5112.

Descriptors: *Anaerobic lagoons, *Seepage, *Animal wastes, *South Carolina, *Groundwater pollution, Groundwater, Water pollution effects, Soils, Swine, Nutrients, Coastal plains, Wells, Chemical oxygen demand.

Groundwater around three swine waste lagoons was monitored for two years to determine the effect on water quality. These earthern lagoons were located in the Coastal Plain Region of South Carolina in an area were groundwater tables may be within 2 m (6 ft) of the surface. Several test wells (10-12) were installed at various distances (2-30 m) (6-100 ft) from each lagoon. Most of the wells did not show any evidence of contaminants, although particular wells did show high concentrations of pollutants (COD, 800 mg/L and TKN, 80 mg/L). Other parameters measured included: NH4-N, NO3-N, pH, electrical conductivity, total coliform, fecal coliform, total organic carbon and chlorides. It is difficult to predict the extent of leakage from these earthern lagoons because of leakage at specific locations. A water balance including precipitation, evaporation and wash water, was done on one swine lagoon for a fifteen month period. The results showed that approximately 20% of the inflow leaked from the lagoon. (Hegg-Clemson U.)
W88-00555

RECYCLING OF SEWAGE EFFLUENT BY SUGARCANE IRRIGATION: A DILUTION STUDY, OCTOBER 1976 TO OCTOBER 1978, PHASE II-A,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3F.
W88-00559

METHOD FOR TREATING THE UPPER LAYER OF A BODY OF WATER,
For primary bibliographic entry see Field 5G.
W88-00569

METHOD FOR REMOVING SLUDGE OR MUD FROM THE BOTTOM OF A WATER AREA,
For primary bibliographic entry see Field 5G.
W88-00590

SOURCES AND FLOW OF HEAVY METALS AND CYANIDE IN THE KOKOMO MUNICIPAL TREATMENT SYSTEM,
Purdue Univ., Lafayette, IN.
K. J. Yost, T. G. adams, and R. F. Wukasch.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142455. Price codes: A24 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 521-543, 1 fig, 23 tab.

Descriptors: *Water treatment facilities, *Wastewater facilities, *Industrial wastewater, Wastewater treatment, Municipal wastewater, Pollutants, Cadmium, Chromium, Nickel, Lead, Zinc, Copper, Cyanide.

A study to establish a protocol to assist communities in identifying and quantifying cyanide and heavy metal discharges to publicly owned treatment works is discussed. Efforts to formulate regulatory policies for reductions of discharges of those materials to the level that land disposal of sludge is feasible are also described. Trunkline sampling was conducted at 12 locations in the test sewer network to monitor specific point sources, including electro-plating facilities, agriculture industries, wire manufacturing, galvanizing works, aluminum plants, and alloy manufacturing plants. Data on inputs of cadmium, chromium, nickel, lead, zinc, copper, and cyanide from each point source are provided. (Halterman-PTT)
W88-00635

LEACHING STUDY OF PNL 76-68 GLASS BEADS USING THE LLNL CONTINUOUS-FLOW METHOD AND THE PNL MODIFIED IAEA METHODS: A FINAL REPORT,
Lawrence Livermore National Lab., CA.
R. W. Buddemeier, D. G. Coles, R. W. Mensing, J. Rego, and H. C. Weed.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-021539. Price codes: A12 in paper copy, A01 in microfiche. August 20, 1982. 250 p, 23 fig, 12 tab, 17 ref, 14 append. Contract No. W-7405-Eng-48.

Descriptors: *Fate of pollutants, *Radioactive waste disposal, *Radioactive wastes, *Leaching, Neptunium, Plutonium, Metals.

Lawrence Livermore National Laboratory (LLNL) has conducted a long-term single-pass continuous-flow (SPCF) leaching test of a glass waste. Leaching rates of neptunium, plutonium and various stable elements were measured at 25C and 75C with three different solutions and three different flow rates. The purposes of the study were: (1) to compare SPCF leaching results with the results of a modified IAEA leach test performed by Pacific Northwest Laboratories (PNL); (2) to establish elemental leach rates and their variation with temperature, flow rate and solutions composition; and (3) to gain insight into the leaching mechanisms. The LLNL and PNL leach tests yielded results which appear to agree within experimental uncertainties. The magnitude of the leach rates determined for neptunium and the glass matrix elements is 10 to the minus 5 power grams of glass/sq cm geometric solid surface area/day. The rates increase with temperature and with solution flow rate and are similar in brine and distilled water but higher in a bicarbonate solution. Other cations exhibit somewhat different behavior, and plutonium in particular yields a much lower apparent leach rate, probably because of sorption or precipitation effects after release from the glass matrix. After the initial few days, most elements are leached at a constant rate. Matrix dissolution appears to be the most probable rate controlling step for the leaching of most elements. (Author's abstract)
W88-00642

SEDIMENT AND RADIONUCLIDE TRANSPORT IN RIVERS: RADIONUCLIDE TRANSPORT MODELING FOR CATTARAUGUS AND BUTTERMILK CREEKS, NEW YORK,
Battelle Pacific Northwest Labs., Richland, WA.
Y. Onishi, S. B. Yabusaki, C. T. Kincaid, R. L. Skaggs, and W. H. Walters.
Available from the National Technical Information Service, Springfield, VA 22161, as NUREG/CR-2425. Price codes: A17 in paper copy, A01 in microfiche. PNL-4111, December 1982. 152 p, 76 fig, 13 tab, 21 ref, 3 append.

Descriptors: *Sediment transport, *Radioisotopes, *Fate of pollutants, *Computer models, *Erosion, Path of pollutants, Models, Model studies, Suspended sediments, Fluvial sediments, Radioactive wastes, Pesticides, Heavy metals.

SERATRA, a transient, two-dimensional, laterally-averaged, computer model of sediment-contaminant transport in rivers, satisfactorily resolved the distribution of sediments and radionuclide concentrations in the Cattaraugus Creek stream system in New York. By modeling the physical processes of advection, diffusion, erosion, deposition, and bed armoring, SERATRA routed three sediment size fractions, including cohesive soils, to simulate three dynamic flow events. SERATRA computed radionuclide levels in dissolved, suspended sediment, and bed sediment forms for Cs137, Sr90, Pu239, Pu240, and H3 radionuclides. Sediment and radionuclide concentrations calculated by SERATRA in the Cattaraugus Creek stream system are in reasonable agreement with measured values. The SERATRA model is being studied as a site assessment tool. It handles not only radionuclides but other contaminants such as pesticides, heavy metals and other toxic chemicals. A final model validation through comparison of predicted results with field data from a carefully controlled tracer test at a field site is recommended, along with a detailed laboratory flume testing to study cohesive sediment transport, deposition and erosion characteristics. (Geiger-PTT)
W88-00655

REVIEW OF GROUND-WATER FLOW AND TRANSPORT MODELS IN THE UNSATURATED ZONE,
Battelle Pacific Northwest Labs., Richland, WA.
C. A. Oster.
Available from the National Technical Information Service, Springfield, VA 22161, as NUREG/CR-2917. Price codes: A08 in paper copy, A01 in microfiche. Report NUREG/CR-2917, PNL-4427, November 1982. 17 p, 1 fig, 2 tab, 15 ref, 5 append.

Descriptors: *Radioactive wastes, *Groundwater movement, *Groundwater pollution, *Saturated flow, *Computer models, *Porous media, Models, Fate of pollutants, Path of pollutants, Model studies, Reviews, Pollutants, Capillary water, Hydrologic models.

Models of partially saturated flow and transport in porous media have application in the analysis of existing as well as future low-level radioactive waste facilities located above the water table. An extensive literature search along with telephone and mail correspondence with recognized leading experts in the field, was conducted to identify computer models suitable for studies of low-level radioactive waste facilities located in an unsaturated zone. Fifty-five existing models were identified as potentially useful. Ten of these models were selected for further examination. This report contains a statement of the groundwater flow-contaminant transport problem, a discussion of those methods used to reduce the physical problem to a computer model, and a brief discussion about the data requirements of these models. The procedure used to select the ten codes for further discussion is given, along with a list of these models. Finally, the Appendices contain the data about the fifty-five codes examined. Specifically Appendix D contains the detailed discussions of each of the ten selected codes. Included in each discussion are such items which a potential user requires in determining whether the code is suitable for his applications. Appendix E contains brief summary information about each of the fifty-five codes. Included in the summaries are identification data, authors, pertinent references, and model type. (Author's abstract)
W88-00656

DIGRD: AN INTERACTIVE GRID GENERATING PROGRAM,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7C.
W88-00657

ESTUARY WATER QUALITY DATA STATISTICAL INTERFACE: SUPPORT ACTIVITIES REPORT.
Texas Natural Resources Information System, Austin.
For primary bibliographic entry see Field 5G.
W88-00671

GEOSTATISTICAL MODELING OF PORE VELOCITY,
Battelle Pacific Northwest Labs., Richland, WA.

J. L. Devary, and P. G. Doctor.
PNL-SA-9096, March 1981. 33 p, 16 fig, 25 ref. Contract No. DE-AC06-76RLO 1830.

Descriptors: *Path of pollutants, *Model studies, *Pore velocity, *Groundwater movement, Solute transport, Hanford Reservation, Statistical analysis, Mathematical studies, Hydrology, Radioactive waste disposal.

A significant part of evaluating a geologic formation as a hazardous waste repository, involves the modeling of contaminant transport in the surrounding media in the event the repository is breached. The commonly used contaminant transport models are deterministic. However, the spatial variability of hydrologic field parameters introduces uncertainties into contaminant transport predictions. This paper discusses the application of geostatistical techniques to the modeling of spatially varying hydrologic field parameters required as input to contaminant transport analyses. Kriging estimation techniques were applied to Hanford Reservation field data to calculate media conductivity and the groundwater potential gradients. These quantities were statistically combined to estimate the groundwater pore velocity and to characterize the pore velocity estimation error. Combining geostatistical modeling techniques with product error propagation techniques, results in an effective stochastic characterization of groundwater pore velocity, a hydrologic parameter required for contaminant transport analyses. (Author's abstract)
W88-00675

STATUS REPORT ON ABATEMENT OF WATER POLLUTION FROM THE CANADIAN PULP AND PAPER INDUSTRY (1982).
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
For primary bibliographic entry see Field 5G.
W88-00676

PREDICTING CHEMICAL MOVEMENT IN SOILS,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
G. A. O'Connor, and F. Khorsandi.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205357/AS. Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. M17, August 1986. 25 p, 3 ref. State Project No. 1345639.

Descriptors: *Computer models, *Solute transport, *Path of pollutants, Model testing, Pesticides, New Mexico, Water pollution sources.

Chemical Movement in Soil (CMIS) is a management/educational computer model that provides qualitative predictions of pesticide fate as a function of key soil, chemical, and climatic variables. Model assumptions limit it to nonpolar pesticides (and other xenobiotics) moving in sandy soils. The purpose of this work was to test and modify the model for chemicals and soils pertinent to New Mexico. Laboratory column studies with a sandy New Mexico soil matched reasonably well with model predictions. The data suggests that the model could be used as first approximations of pesticide behavior in New Mexico soils. It is primarily useful as an educational instrument for students and extension personnel examing implications of various management practices in worst-case scenarios. (O'Connor-NM St. U.)
W88-00719

PRELIMINARY STUDIES CHARACTERIZING WASTEWATER FROM THE INTENSIVE CULTURE OF CHANNEL CATFISH AND NITRIFICATION IN LABORATORY SCALE SUBMERGED FILTERS,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W88-00723

FORMATION OF TOXAPHENE-LIKE CONTAMINANTS DURING SIMULATED PAPER PULP BLEACHING,
Illinois Univ. at Urbana-Champaign. Environmental Research Labs.
For primary bibliographic entry see Field 5D.
W88-00728

DISPOSITION OF TETRACHLORODIBENZO-P-DIOXIN IN SOIL,
Missouri Univ.-Columbia. Environmental Trace Substances Research Center.
J. Palausky, S. Kapila, and S. E. Manahan.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207031/AS. Price codes: A02 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, Columbia. September 1986. Final Report, F.Y. 1984. 20 p, 7 fig, 2 tab. Contact No. 14-08-0001-G916. Project No. USGS G916-04.

Descriptors: *Tetrachloro-p-dioxins, *Solvent effects, *Path of pollutants, *Fate of pollutants, Vapor-phase migration, Soil contamination.

The objective of this study was to monitor the extent of vapor phase migration and the effect of solvent (co-pollutant) on movement of TCDD in soil. The migration of TCDD was studied in soil columns in the laboratory. The columns were spiked with known amount of TCDD. Vertical migration soil column sections were monitored with sampler capable of sectioning columns in 1 mm increments. The results obtained showed a significant migration of TCDD in soil at temperatures 30. In absence of erosion vapor phase migration is perhaps the dominant parameter governing the loss and fate of TCDD and other similar compounds in soil. Furthermore, the fate and rate of loss are related to the initial depth of penetration of TCDD, which is strongly dependent on the nature of solvent (co-pollutant). (Kapila-U. MO)
W88-00730

EFFECTS OF SODIUM HYDROXIDE SOLUTIONS ON THE PERMEABILITY OF MAGNESIUM CLAYS,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
G. W. Denise, and R. W. Stephenson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207114/AS. Price codes: A03 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, Columbia. September 1985. Final Report, F.Y. 1984. 27 p, 10 fig. Contract No. 14-08-0001-G916. Project No. USGS G-916-03.

Descriptors: *Permeability, *Clay, *Hazardous wastes, *Unsaturated flow, *Liners, *Seepage control, Soil water movement, Path of pollutants, Water pollution control.

Relationships for permeability of kaolinite versus degree of saturation and permeability versus flow are developed for 0.005 N calcium sulphate, xylene and aniline permeants using the triaxial flexible wall permeammeter. The clay was statistically compacted at degrees of saturation of 50%, 75% and 100%. A gradient of 277 was used for the permeability tests. The initial degree of saturation was inversely related to the permeability of the clay. Saturated clay samples were found to be virtually impervious to aniline and xylene. As the degree of saturation decreased, the permeability increased with the initial volume of flow equivalent to the volume of air space and saturating the sample. Subsequent flow occurred at a stabilized permeability. The stabilized permeability is independent of the initial degree of saturation for the standard permeant (0.005 N calcium sulphate). (Stephenson-U. of MO-Rolla)
W88-00731

SURVEY OF POTENTIAL POPULATION EXPOSURES TO CHEMICAL CONTAMINANTS PRESENT IN UNPROTECTED SURFACE WATER SUPPLIES IN NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
A. G. Turner, F. A. DiGiano, and P. M. DeRosa.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205761/AS. Price codes: A05 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh. Completion Report No. 213, January 1984. 79 p, 11 fig, 11 tab, 8 ref, append.

Descriptors: *North Carolina, *Water pollution sources, *Pollutant identification, *Wastewater discharge, Water supply, Wastewater, Runoff, Chemical wastes, Watershed protection.

Existing data from state and federal sources were used to identify North Carolina's surface water supplies, populations served, and point source discharges into surface waters. This information was combined to create a new computer data base which can be used to identify facilities that discharge upstream of surface water supplies. In addition, state wide use of agricultural pesticides was estimated as a first step in assessing potential nonpoint source pollutants. Currently, little organized information is available to establish a complete chemical profile of each point source of wastewater discharge. Even less is known about the chemicals contributed by nonpoint sources such as agricultural and urban runoff. This preliminary study suggests the need for an integrated data management system linking surface water supply systems to all potential sources of chemical contamination. The specific chemicals entering surface waters must be estimated or, better yet, measured so that potential risks may be evaluated. As a first step, the organic chemical contaminants in raw water supplies extracted from those surface waters considered most vulnerable to upstream wastewater discharges should be identified and their removal by water treatment measured. (Kiger-UNC-WRRI)
W88-00736

PRESENT AND POTENTIAL IMPACTS OF TOXIC SUBSTANCES ON MUNICIPAL GROUND WATER RESOURCES IN NORTH CAROLINA,
North Caolina State Univ., Raleigh. Div. of University Studies.
For primary bibliographic entry see Field 5G.
W88-00737

HYDROSPHERIC TRACE ELEMENTS AND THEIR APPLICATION IN TRACING WATER POLLUTANTS,
Oregon State Univ., Corvallis. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-00740

LONG TERM SEDIMENT DEPOSITION IN THE RIPARIAN ZONE OF AN AGRICULTURAL WATERSHED,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 2J.
W88-00742

MASSACHUSETTS ACID RAIN MONITORING PROJECT: PHASE I,
Massachusetts Univ., Amherst. Water Resources Research Center.
P. J. Godfrey, A. Ruby, and O. T. Zajicek.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201125/AS. Price codes: A11 in paper copy, A01 in microfiche. Technical Completion Report, Massachusetts, Publication No. 147, January 1985. 240 p, 42 fig, 38 tab, 52 ref, 6 app. Contract No. 14-08-0001-G848. Project No. USGS G848-23.

Descriptors: *Acid rain, *Acid streams, *Acidic soils, *Acidic water, *Acidity, *Alkalinity, Anions, Anion exchange, Cations, Cation exchange, Laboratory equipment, Test facilities, Mineralogy, Geochemistry, Surface water, Surveys, Monitoring, Heavy metals, Color, Precipitation, Seasonal variation, Massachusetts.

In an effort to assess the sensitivity of Massachusetts surface waters to acid deposition, approxi-

mately 40% of Massachusetts fresh water surface waters were included in a statewide water chemistry survey conducted from March 1983 to April 1984. Samples were collected monthly by volunteers and analyzed for pH and alkalinity at local volunteer laboratories. Quarterly analyses of samples for major anions and cations, aluminum and color were done at the University of Massachusetts. The vast majority of waters studied were found to be sensitive to long-term acidification. (78% of samples had alkalinity < or = 20 mg/L and 19% were < or = 2 mg/L. Geographical and seasonal variations in surface water chemistry were significant. A statistically significant decrease in average monthly alkalinity (11.3 to 9.5 mg/L) was observed in a comparison of Spring 1983 data with Spring 1984 data, but no firm conclusions regarding on-going, long-term acidification of Massachusetts' surface waters are made pending more detailed analysis of the data. Quarterly analysis of samples for major anions and cations, aluminum and color indicated that the likely source of high surface water acidity and sulfate concentrations is atmospheric deposition of strong mineral acids. Calculation of the Calcite Saturation Index and application of two acidification models are discussed. (Kaynor-U. MA)
W88-00745

APPLICATION OF STREAMFLOW TRANSPORT MODELS TO THE YAKIMA RIVER, WASHINGTON,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 6G.
W88-00782

1983 ANNUAL REPORT TO THE PRESIDENT AND CONGRESS: NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM.
Interagency Task Force on Acid Precipitation, Washington, DC.
72 p, 15 fig, 7 tab.

Descriptors: *Acid rain, *Water pollution sources, *Water pollution effects, *Research priorities, *Fate of pollutants, Decision making, Management planning, Air pollution, Water pollution, Project planning, Acidic water, Future planning.

This report summarizes the major scientific issues that were addressed by the National Acid Precipitation Assessment Program in 1983, and the progress of researchers in reducing the uncertainties of assessing causes, effects, and management of acid deposition. The report has four parts. Part one summarizes the progress and accomplishments of the National Program. The introduction provides information about the Task Force's and National Program's history, organization, funding, and management. Part three discusses the evolving science of acid deposition and changes that have occurred as a result of new research findings. The fourth part contains a detailed overview of the progress and specific accomplishments within each research area of the National Program. The areas covered in part four include: natural sources, man-made sources, atmospheric processes, deposition monitoring, aquatic effects, terrestrial effects, effects on materials and cultural resources, control technologies, assessments, and international activities. Within each research area's overview section are examples of the accomplishments, discussion of the research goals, and proposed future activities. (Geiger-PTT)
W88-00786

OIL POLLUTION RESEARCH, 1984,
Maine State Dept. of Marine Resources, Augusta.
D. J. Card, L. T. Stockwell, and E. S. Gilfillan.
1984. 456 p, 8 fig, 15 tab, 351 ref.

Descriptors: *Oil pollution, *Oil spills, *Maine, *Marine animals, Marine environment, Environment, Cleanup operations, Literature review.

The results of oil pollution research specifically relating to oil spill protection and damage assessment, conducted for the Maine Department of Environmental Protection, are presented. An inventory of selected marine resources of Penobscot Bay, Maine, and laboratory studies on the comparative effects of naturally and chemically dispersed oil on several nearshore marine species are detailed. The study had four parts: resources inventory (identification and survey of selected marine resources susceptible to oil spill damage); pollution studies; literature review; and the assessment of the consequences of any major oil spill occurring during the course of the one-year program. A catalogue is presented of the marine resources of Penobscot Bay, listed by priority. An extensive table of toxicity of oil to marine finfish, compiled from the literature, is included, along with a table of sublethal effects of oil on other marine invertebrates. Five studies on the effects of No. 2 fuel oil, dispersed crude oil, and sediment bound oil on various marine organisms are detailed. An oil spill contingency plan is presented. (Halterman-PTT)
W88-00799

EVALUATION OF URBAN NONPOINT SOURCE POLLUTION MANAGEMENT IN MILWAUKEE COUNTY, WISCONSIN; VOLUME I: URBAN STORMWATER CHARACTERISTICS, POLLUTANT SOURCES AND MANAGEMENT BY STREET SWEEPING,
Wisconsin Dept. of Natural Resources, Madison.
R. Bannerman, K. Baun, M. Bohn, P. E. Hughes, and D. A. Graczyk.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-114164. Price codes: A10 in paper copy, A01 in microfiche. 1983. 191 p, 57 fig, 62 tab, 43 ref. Contract No. P005432-01-5.

Descriptors: *Nonpoint pollution sources, *Pollution load, Water pollution control, Water pollution prevention, Management planning, Planning, Milwaukee County, Wisconsin, Storm water, Storm runoff, Storm sewers, Storm drains.

The findings, conclusions and recommendations of a study of the characteristics, sources and management of urban stormwater pollution in Milwaukee, Wisconsin are presented in a three-volume report. The impacts of urban stormwater are described, and the feasibility and application of urban nonpoint source water pollution treatment measures are discussed. Volume 1 contains the technical findings, conclusions, and recommendations related to urban stormwater quantity, quality, impacts, pollutant sources and management. (See W88-00809 thru W88-00811) (Halterman-PTT)
W88-00808

EVALUATION OF URBAN NONPOINT SOURCE POLLUTION MANAGEMENT IN MILWAUKEE COUNTY, WISCONSIN: EXECUTIVE SUMMARY,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5G.
W88-00809

EVALUATION OF URBAN NONPOINT SOURCE POLLUTION MANAGEMENT IN MILWAUKEE COUNTY, WISCONSIN; VOLUME II: FEASIBILITY AND APPLICATION OF URBAN NONPOINT SOURCE WATER POLLUTION ABATEMENT MEASURES.
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5G.
W88-00810

EVALUATION OF URBAN NONPOINT SOURCE POLLUTION MANAGEMENT IN MILWAUKEE COUNTY, WISCONSIN; VOLUME III: STUDY SITE CHARACTERISTICS, EXPERIMENTAL METHODS AND QUALITY ASSURANCE PROGRAM,
Wisconsin Dept. of Natural Resources, Madison.
J. Hansen, M. Sesing, P. Hughes, and D. Graczyk.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-114180. Price codes: A09 in paper copy, A01 in microfiche. 1983. 165 p, 30 fig, 46 tab, 35 ref, 2 append. Contract No. P005432-01-5.

Descriptors: *Nonpoint pollution sources, *Pollution load, Water pollution control, Water pollution prevention, Management planning, Planning, Milwaukee County, Wisconsin, Storm water, Storm runoff, Storm sewers, Storm drains.

The findings, conclusions and recommendations of a study of the characteristics, sources and management of the urban stormwater pollution in Milwaukee, Wisconsin are presented in a three-volume report. The impacts of urban stormwater are also described, and the feasibility and application of urban nonpoint source water pollution treatment measures are discussed. Volume 3 contains the materials and methods, quality assurance, and other supportive and ancillary material related to this project. (See W88-00808 thru W88-00810) (Halterman-PTT)
W88-00811

TNRIS FOREST SERVICE SOUTHERN PINE BEETLE INFESTATION MAPPING: SUPPORT ACTIVITIES REPORT.
Texas Natural Resources Information System, Austin.
August 1977. 19 p, 5 fig, 2 tab, 2 ref, 4 append.

Descriptors: *Southern Pine Beetle, *Lindane, Insect control, Environmental effects.

The Texas Natural Resources Information Systems (TNRIS) has assisted the Texas Forest Service (TFS) is carrying out public education related to the Forest Pest Control Program. This report details the assistance provided by TNRIS to the Texas Forest Service in carrying out work to detect and control southern pine beetle infestations. Methods used to control pine beetle infected trees involved felling the tree or chemical treatment with lindane. Using data supplied by the Texas State Forest Service, TNRIS has produced computer maps, utilizing the capabilities of the Geographical Information System (GIS), which detail the location, size and activity status of the southern pine beetle infestations in East Texas. These computer produced maps have been used to illustrate the statewide distribution of southern pine beetle activity and to document visually the extent to which beetle activity shifts geographically from year to year. (Halterman-PTT)
W88-00817

GREAT LAKES WATER QUALITY BOARD, REPORT TO THE INTERNATIONAL JOINT COMMISSION, 1985 REPORT ON GREAT LAKES WATER QUALITY.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Regional Office.
Presented June 1985, Kingston, Ontario. 212 p, 25 fig, 45 tab, 40 ref, append.

Descriptors: *Water quality control, *Lakes, *Great Lakes, Phosphorus, International agreements, Canada, International Joint Commission, Fate of Pollutants, Monitoring, Fish, Aquatic life, Pesticides, Regulations, Risk, Nitrogen, Eutrophication, Wastewater disposal.

The Great Lakes Water Quality Board reports on five issues: persistent toxic substances, areas of concern, phosphorus control, environmental status of lakes and connecting channels, and Agreement progress. Several recommendations were made concerning toxic substances. The Board supported (1) development of a systematic bioeffects and ecosystem health monitoring program, (2) continuation of development and application of suitable diagnostic techniques for assessing sublethal effects of contaminants of fish and other aquatic organisms, and (3) monitoring of lead concentrations and establishment of consumption guidelines for lead in fish. New criteria for areas of concern were prepared. According to these criteria 42 water bodies were designated areas of concern. New areas are of Torch Lake and Deer Lake-Carp Creek-Carp River in the Lake Superior basin and the Kalamazoo River in the Lake Michigan basin. With respect to phosphorus, Lakes Superior and Michigan are oligotrophic with a few nearshore

areas classified mesotrophic. Although phosphorus levels in Lake Huron are the same as in 1971, nitrogen levels have increased. Phosphorus levels in Lake Erie have declined but are spatially variable. Lake Ontario's phosphorus levels have steadily decreased. Among the surveillance issues are recommendations to study dieldrin in gull eggs and fish, increasing nitrogen levels in the lakes, and fish tumors. Actions of Canada, the United States, and state jurisdictions are reported for programs and regulations, dischargers, hazardous waste, media-specific activities, and activities regarding specific toxic substances. (Cassar-PTT)
W88-00821

SOUTH AFRICAN MARINE POLLUTION MONITORING PROGRAMME: 1979-1982.
National Programme for Environmental Sciences, Pretoria (South Africa). Committee for Marine Pollution.
Available from the National Technical Information Service, Springfield, VA 22161, as N83-11612. Price codes: A04 in paper copy, A01 in microfiche. Report No. 51, July 1981. Edited by Dr. C. E. Cloete and Dr. R. J. Watling. 52 p, 21 fig, 53 ref.

Descriptors: *Marine pollution survey, *Marine pollution, Monitoring, South Africa, Pollution, Estuarine environment, Pollutants, Pollution sources, Chemical properties, Hazardous materials, Chlorinated hydrocarbons, Silting.

A National Marine Pollution Survey Program was initiated in South Africa in 1974 in order to discover and monitor sources of marine pollution, to establish coastal monitoring stations, and to establish a national data center. Changes in the pollution status of selected impact sites were monitored and assessed from 1979 through 1982. This report details available background information on each site, as well as sampling locations, sampling parameters, environmental parameters measured at the time of sampling, and the frequency of sampling. No data are provided for the 26 study sites that are included. (Halterman-PTT)
W88-00824

POTENTIAL FOR BIOMAGNIFICATION OF CONTAMINANTS WITHIN MARINE AND FRESHWATER FOOD WEBS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
S. H. Kay.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-150747. Price codes: A08 in paper copy, A01 in microfiche. Technical Report D-84-7, November 1984. Final Report. 166 p, 14 fig, 69 tab, 132 ref.

Descriptors: *Fate of pollutants, *Literature reviews, *Dredging, *Aquatic habitats, *Bioaccumulation, Accumulation, Heavy metals, Metals, Pesticides, Insecticides, Herbicides, Organic compounds, Sediments, Food chains, Aromatic compounds, Environmental effects, Aquatic life.

This report reviews the literature on the biomagnification of toxic heavy metals and organic contaminants within marine and freshwater food webs and is limited to gill-breathing species. The toxic metals included arsenic, cadmium, chromium, copper, lead, mercury (both inorganic and methylmercury), nickel, selenium, silver, tin and zinc. Organic contaminants included in the review were polychlorinated biphenyls (PCB), DDT and its derivatives, dieldrin, endrin, kepone, mirex, atrazine, endosulfan, lindane, chlorinated phenols, chlorinated benzenes, and polynuclear aromatic hydrocarbons (PAH). The few contaminants which appeared to have the potential to biomagnify in aquatic systems included methylmercury, PCB, possibly kepone and mirex, and some PAHs, including benzo(a)pyrene and naphthalenes. Based upon the information reviewed, it may be concluded that the biomagnification of contaminants in marine and freshwater food webs is not a dramatic phenomenon. As the biological availability of contaminants from sediments should be similar regardless of whether or not these sediments have been dredged and placed in an open-water disposal site, it is unlikely that open-water disposal of contaminated dredged material will cause any widespread perturbations in marine or freshwater ecosystems. Existing data gaps were identified, and recommendations were made for guiding research efforts on the question of contaminant biomagnification in aquatic food webs. (Author's abstract)
W88-00839

CHARACTERIZATION OF ANAEROBIC CHEMICAL PROCESSES IN RESERVOIRS: PROBLEM DESCRIPTION AND CONCEPTUAL MODEL FORMULATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W88-00843

LIMNOLOGICAL STUDIES AT EAU GALLE LAKE, WISCONSIN, REPORT 1: INTRODUCTION AND WATER QUALITY MONITORING STUDIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W88-00847

SPECTROPHOTOMETRIC ANALYSIS OF CHLOROPHYLL A IN FRESHWATER PHYTOPLANKTON,
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W88-00854

ELEMENTAL COMPOSITION OF SUSPENDED PARTICULATE MATTER IN THE LOWER DUWAMISH RIVER AND ELLIOT BAY, WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
G. J. Massoth, R. A. Feely, and M. F. Lamb.
NOAA Technical Memorandum OMPA-17, June 1982. 41 p, 16 fig, 5 tab, 35 ref.

Descriptors: *Particulate matter, *Suspended load, *Washington, *Suspended sediments, Flocculation, Iron, Chromium, Nickel, Copper, Zinc, Lead, Duwamish River, Elliot Bay.

Trace element concentrations of suspended-particulate matter in the Duwamish River and Elliot Bay were determined from samples collected in February 1980. The results show significant enrichments of Fe, Cr, Ni, Cu, Zn, and Pb in suspended matter from the Duwamish River estuary which is attributed to flocculation processes. In Elliot Bay, the trace-element-enriched particulates from the Duwamish River form a narrow plume that flows north across the inner Bay and westward along the northern coast where it eventually disperses into the outer Bay and central basin of Puget Sound. In subsurface, near-bottom particulate matter from Elliot Bay significant correlations exist between a number of the trace elements and manganese. These data suggest that newly formed hydrous manganese oxide coatings in the subsurface particulate matter effectively scavenge several trace elements, including Cr, Ni, Cu, Zn, and Pb. The biological implications of these results are discussed. (Author's abstract)
W88-00876

BIOACCUMULATION OF CONTAMINANTS FROM BLACK ROCK HARBOR DREDGED MATERIAL BY MUSSELS AND POLYCHEATES,
Environmental Research Lab., Narragansett, RI.
J. Lake, G. L. Hoffman, and S. C. Schimmel.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-157365. Price codes: X00 in paper copy, X00 in microfiche. Technical Report D-85-2, February 1985. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 150 p, 36 fig, 28 tab, 2 append. (microfiche).

Descriptors: *Marine pollution, *Water pollution effects, *Black Rock Harbor, *Connecticut, Polychaetes, Mussels, Polychlorinated biphenyls, Marine sediments, Ocean dumping, Biological magnification.

Mussels (Mytilus edulis) and worms (Nereis virens) were exposed to dredged materials from Black Rock Harbor, Connecticut, in laboratory conditions, to examine the bioaccumulation of organic and inorganic contaminants. Black Rock Harbor sediment samples were collected at 25 locations within the study area using a gravity box corer to a depth into the substrate of 1.21 m. Mussels were dosed with a constant concentration of suspended particulates, from a slurry of the sediment samples, and fed algae. Mussels showed increases in concentration of two to three orders of magnitude for organic contaminants, and metals showed increases of less than a factor of 12. Worms were exposed to bedded sediments in aquaria under flowing seawater. Worms exposed for 28 days accumulated polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) to concentrations one to three orders of magnitude above those found in reference organisms. Chromium and copper were the only metals found to accumulate higher in test animals than in reference animals. The work described here suggests that modeling bioaccumulation of some organic compounds as a partitioning of contaminants between sediments and organisms may have promise as a generalized predictive technique. (Halterman-PTT)
W88-00891

BIOLOGICAL EFFECTS AND INTERACTIONS OF PESTICIDES IN A SOIL-PLANT-WATER MICROCOSM,
Corvallis Environmental Research Lab., OR.
J. D. Gile.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-166165. Price codes: A02 in paper copy, A01 in microfiche. EPA-600/D-82-272, August 1982. Environmental Research Brief. 9 p, 2 fig, 7 tab, 22 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Ecosystems, *Food chains, *Soil-water-plant relationships, Chemical reactions, Pesticides, Carbamate pesticides, DDT, Lindane, Soil bacteria, Organophosphorus pesticides, Nutrients, Soil types.

A soil-plant-water microcosm was used to develop a data base for pesticide transport and metabolism and to determine the effects of varying environmental conditions and/or components on chemical movement in a terrestrial ecosystem. The system was used in a comparative transport study with lindane, fonofos, parathion, phorate, DDT, and carbofuran. The results demonstrated the importance of chemical structure, water solubility, and soil type in predicting comparative chemical behavior. The system was also employed in studies of the effects of crop abundance on chemical movement and the interactions between agricultural chemicals that can affect chemical movement. Studies were also conducted on the effects of plant type, plant nutrition, soil microorganisms, chemical interactions on pesticide transport, and metabolism. These studies emphasize the importance of ecosystem interactions in determining chemical transport through ecosystems and into food chains. (Author's abstract)
W88-00909

EFFECTS OF LIVESTOCK PASTURING ON NONPOINT SURFACE RUNOFF,
Ohio Agricultural Research and Development Center, Wooster.
R. K. White, R. W. VanKeuren, L. B. Owens, W. M. Edwards, and R. H. Miller.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-165456. Price codes: A09 in paper copy, A01 in microfiche. EPA-600/2-83-011, February 1983. 167 p, 27 fig, 12 tab, 11 ref, 9 append.

Descriptors: *Farm wastes, *Agricultural runoff, *Water pollution sources, *Nonpoint pollution sources, Agricultural watersheds, Agriculture, Pas-

ture management, Pastures, Grasslands, Animal wastes, Range management.

The effects of livestock pasturing on the quality of nonpoint surface runoff are evaluated, with emphasis on the humid regions of the United States. Three pasturing regimes which are commonly practiced in the corn belt states were evaluated to determine their potential contribution to nonpoint source pollution. These regimes are summer rotational grazing and winter feeding of hay on one pasture, summer rotational grazing with no livestock on pastures in the winter, and winter rotational grazing of autumn regrowth with feeding of field stored hay. Winter pasturing and feeding of hay caused a marked increase in the number of runoff events and the volume of runoff as compared to previous meadow practices and to summer pasturing only. Dormant (Nov-April) season nutrient fluxes were greater than those in the growing (May-Oct) season. Analysis of the soluble and the sediment fraction of the runoff samples indicated that the nutrients were principally in the soluble phase. (Halterman-PTT)
W88-00910

SAN FRANCISCO BAY AREA NATIONAL URBAN RUNOFF PROJECT. DEMONSTRATION OF NON-POINT SOURCE POLLUTION MANAGEMENT ON CASTRO VALLEY CREEK: EXECUTIVE SUMMARY.
Alameda County Flood Control and Water Conservation District, Hayward, CA.
For primary bibliographic entry see Field 5G.
W88-00914

SAN FRANCISCO BAY AREA NATIONAL URBAN RUNOFF PROJECT: A DEMONSTRATION OF NON-POINT SOURCE POLLUTION MANAGEMENT ON CASTRO VALLEY CREEK; APPENDIX.
Alameda County Flood Control and Water Conservation District, Hayward, CA.
For primary bibliographic entry see Field 5G.
W88-00915

STUDY OF THE EFFECTS OF OIL ON CETACEANS,
Guelph Univ. (Ontario).
For primary bibliographic entry see Field 5C.
W88-00918

CLEANING UP THE DELAWARE RIVER, A STATUS AND PROGRESS REPORT PREPARED UNDER THE AUSPICES OF SECTION 305(B) OF THE FEDERAL CLEAN WATER ACT,
Delaware River Basin Commission, Trenton, NJ.
For primary bibliographic entry see Field 5G.
W88-00920

1983 REPORT ON GREAT LAKES WATER QUALITY.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
November 1983. 89 p, 2 fig, 11 tab.

Descriptors: *Great Lakes, *Phosphorus, *Phosphorus compounds, *Administrative regulations, *Algal growth, *Diatoms, *Impaired water quality, Lake basins, Industrial wastes, Administration, Administrative agencies, Mercury, Algae.

This report is the tenth annual report prepared under the 1972 and 1978 Canada-United States Great Lakes Water Quality Agreements. In 1982 the municipal wastewater treatment plants in the Lake Erie Basin were found to achieve an overall average effluent phosphorus concentration of less than 1.0 mg/liter, and thereby met the phosphorus loading reductions required in the 1972 Agreement. While industrial phosphorus inputs do not constitute a major system-wide problem, their contribution to specific areas of concern demands greater jurisdictional attention. Continued imposition of basin-wide limitations on the phosphorus content of laundry detergents is recommended. The mean total phosphorus concentrations measured in Lake Huron have not changed significantly since 1971. It is concluded that this condition meets the non-degradation requirement for the Upper Lakes as stipulated in the 1978 Agreement. In Saginaw Bay, from 1974 to 1980 algal species composition changed from a predominance of blue-green species to diatoms and green algae. This reflection of improved water quality can be attributed to phosphorus controls implemented in local watersheds which drain into the bay. Decreased concentrations of PCBs, DDT, mercury and other contaminants in fish flesh and bird eggs noted during the 1970s appear to have ended in some lakes and in some cases, concentrations may be increasing again. In Lake Superior, PCB levels in lake trout still exceed the Agreement objective. (Hawkins-Omniplan)
W88-00927

1983 ANNUAL REPORT -- REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE.
International Joint Commission-United States and Canada, Windsor (Ontario). Aquatic Ecosystem Objectives Commission.
Report to the International Joint Commission, Windsor, Ontario, November 1983. 63 p, 3 fig, 13 tab, 191 ref, append.

Descriptors: *Lake basins, *Policy making, *Escherichia coli, *Pseudomonas, *Enteric bacteria, *Hazardous materials, *Public health, *Human diseases, *Recreation demand, *Administrative regulations, Pathogens, Pollutants, Aromatic hydrocarbons.

The setting of water quality objectives for existing and newly considered chemicals in Great Lakes water has been a concern of this Committee since 1978, based on standards set by earlier committees since 1972. The establishment of precise relationships between indicator and specific bathing-related illness is desirable for use in regulatory criteria. For the protection of human recreational users of nearshore waters from increased gastrointestinal illnesses, the enterococcus (mE) geometric mean level should not exceed 11/100mL; similarly, the Escherichia coli (mTEC) geometric mean level should not exceed 23/100mL. Mean levels should be monitored by analyzing a minimum of five samples from one location collected over a four-week period. No more than 25% of the analyses should have levels of Pseudomonas aeruginosa (mPA method) greater than 10/100 mL. For the protection of aquatic life, the maximum waterborne concentration of diazinon shall not exceed 0.003 micrograms/L, except that it may range up to 0.1 micrograms/L once every 30 or more days, for periods not to exceed two days. In addition, the levels of benzo(a)pyrene in the sediments or in organisms serving as a food source for fish should not exceed 1.0 micrograms/g; levels of benzo(a)pyrene in water should be less than 0.01 micrograms/L. Other 3-5 ring polynuclear aromatic hydrocarbons have been observed in the ecosystem and some of these are carcinogenic. (Hawkins-Omniplan)
W88-00928

1983 REPORT ON GREAT LAKES WATER QUALITY -- APPENDIX: DREDGING SUBCOMMITTEE REPORT.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
August 1983. 33 p, 2 tab.

Descriptors: *Great Lakes, *Harbors, *Dredging, *Bioassay, *Waste disposal, *Lake sediments, *Administrative decisions, *Project planning, Priorities, Policy making, Site selection, Standards, Pollutants, Elutriate tests, Lake basins.

This report contains a summary of the major findings, conclusions and recommendations of the Dredging Subcommittee pertaining to a bioassessment of Toronto and Toledo Harbor sediments, development of criteria and guidelines for open-lake disposal site selection and Great Lakes dredging in Lake Erie in an ecosystem perspective. Previous projects have included preparing guidelines and a register for evaluating Great Lakes dredging projects, and evaluating dredged material disposal options for two Great Lakes harbors. In the Toledo-Toronto Harbors study, it was recommended that further refinement and standardization of currently available elutriate test and sediment bioassessment techniques be undertaken, and that additional simplified and reliable but less expensive methods be developed. An estimated 40% of the material from Great Lakes dredging is disposed of in the open lake. Recommended guidelines for selection of a disposal site should be compatible with the characteristics of the dredged material to the extent practicable, use of the smallest practicable disposal area, use of current and past dredged material disposal sites that meet guidelines, and minimization of the dispersal, erosion and slumping of the material. The use of open lake areas should not conflict with other high priority uses such as navigation, commercial fishing, or mineral extractions. As a result of the study on the Lake Erie ecosystem dredging, dredging was found to be a minor source of contaminant loading. (Hawkins-Omniplan)
W88-00931

PHASE II: FLOW THROUGH CLAY LINERS,
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-00961

5C. Effects Of Pollution

ELEMENTARY CHEMICAL COMPOSITION (C, H, N) AND ENERGY EQUIVALENT OF ACARTIA CLAUSI (CRUSTACEA: COPEPODA), AN IMPORTANT SPECIES IN THE BIOENERGETICS OF THE COASTAL ECOSYSTEMS OF THE NORTHWEST MEDITERRANEAN (COMPOSITION CHIMIQUE ELEMENTAIRE (C, H, N) ET EQUIVALENT ENERGIE D'ACARTIA CLAUSI (CRUSTACEA: COPEPODA), ESPECE IMPORTANTE DANS LA BIOENERGETIQUE DES ECOSYSTEMES COTIERS DE MEDITERRANEE NORD-OCCIDENTALE),
Centre d'Oceanologie de Marseille (France).
P. Kerambrun.
Marine Biology MBIOAJ, Vol. 95, No. 1, p 115-121, June 1987. 1 tab, 56 ref.

Descriptors: *Water pollution effects, *Eutrophication, *Copepods, *Carbon, *Nitrogen, *Energy, *Urbanization, *Chemical somposition, Crustaceans, Plankton, Seasonal variation, Coasts, Water pollution effects, Mediterranean Sea, Marseilles, France.

Carbon, hydrogen, and nitrogen content were investigated in natural populations of the crustacea copepod Acartia clausi collected during 1980-1982 from different areas near Marseille. (1) the coastal area of Cortiou which receives wastewaters from Marseilles: (2) the eutrophic and polluted Fos Gulf; and (3) offshore areas of the Marseilles Gulf. Energy equivalents were determined in order to examine the ecological role of A. clausi from a bioenergetic point of view. Carbon content ranged from 38.9% of body dry weight (DW) in the open sea off Marseilles to 45.5% of DW in an open basin at Fos in winter, nitrogen content from 10.4% of DW in the open sea off Marseilles in winter to 13.6% of DW in the open basins at Fos in summer. These values agree with the ranges reported in the literature for non-lipidic copepods. Carbon to nitrogen ratios ranged between 3.22 and 3.80. In the open basins at Fos, the mean value in summer (3.30) was significantly different from that in winter (3.70). In the Cortiou area, no seasonal differences emerged. For the three areas, energy equivalents ranged from 4.28 to 5.00 cal/mg DW. Highest values were recorded at Cortiou and Fos (environments where particulate organic matter is abundant and relatively invariable). In these populations, the energy equivalent per unit dry weight did not change significantly throughout the year. The values recorded agreed with the means reported in the literature for non-lipidic species, but were

far below those recorded for species which can store lipids. A. clausi is one of the most abundant copepod species throughout the year in the plankton of these coastal areas, and its steady energy content, with little seasonal variation, makes it an important element in the bioenergetics of the northwest Mediterranean coastal ecosystems. (Author's abstract)
W88-00048

TOXICITY OF FENVALERATE AND ITS CONSTITUENT ISOMERS TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS, AND BLUEGILL, LEPOMIS MACROCHIRUS,
Iowa State Univ., Ames. Dept. of Entomology.
S. P. Bradbury, D. M. Symonik, J. R. Coats, and G. J. Atchison.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 727-735, May 1987. 1 fig, 4 tab, 14 ref. EPA Grant 810659-01-0.

Descriptors: *Water pollution effects, *Pesticides, *Insecticides, *Toxicity, *Fenvalerate, *Fathead Minnow, *Bluegill, *Pyrethroid insecticides, *Lethality tests, Gas-liquid chromatography, Fish, Stereochemistry.

The influence of emulsifiers on the lethality and uptake of fenvalerate in fathead minnows and bluegill was evaluated. A geometric series of five exposure concentrations and a control treatment were used. To determine the whole-body residue levels, fathead minnows exposed to various fenvalerate preparations were pooled and analyzed by chamber. To evaluate enantiomer toxicity, bluegill were exposed via an intraperitoneal injection. Technical and EC fenvalerate formulations were extremely toxic to fathead minnows. The toxicities of the two isomer mixtures were markedly different from the technical material: one isomer mixture was 3.3 times more toxic than the technical formulation and the other was significantly less toxic. Whole-body concentrations of fenvalerate gradually increased with increasing exposure level. Time to mortality was consistent among preparations, with the most lethal concentrations eliciting mortality within 10 to 15 h. Results indicated no significant difference between lethalities of technical and EC formulations. (Main-PTT)
W88-00075

EFFECTS OF TEMPERATURE ON THE ACUTE TOXICITY OF HEAVY METALS (CR, CD, AND HG) TO THE FRESHWATER CRAYFISH, PROCAMBARUS CLARKII (GIRARD),
Valencia Univ. (Spain). Dept. of Animal Physiology.
J. Del Ramo, J. Diaz-Mayans, A. Torreblanca, and A. Nunez.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 736-741, May 1987. 4 fig, 2 tab, 17 ref.

Descriptors: *Toxicity studies, *Heavy metals, *Crayfish, *Temperature effects, *Chromium, *Cadmium, *Mercury, *Lake Albufera, *Water pollution effects, Industrial wastes, Sewage, Lethal limits.

The degree of toxicity of Cr, Cd, and Hg to freshwater crayfish at various temperatures was evaluated. Groups of ten crayfish were kept in water with several metal concentrations. All tests were conducted under static conditions. The percentages of mortality were calculated in each concentration after 96 h. Mercury had the most toxic effect on the crayfish followed by Cd and Cr. The toxic effects of Cd and Hg increased with increasing temperature. Crayfish from Albufera Lake present a high resistance to the heavy metals pollution probably as a result of the detoxification of the heavy metals by metallothioneins. (Main-PTT)
W88-00076

ACUTE TOXICITY OF ENDOSULFAN TO CRAB: EFFECT ON TRANSPORT PROPERTY OF HAEMOCYANIN,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
P. Vijayakumari, D. C. Reddy, and R. Ramamurthi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 742-747, May 1987. 2 fig, 3 tab, 22 ref.

Descriptors: *Pesticides, *Insecticides, *Toxicity, *Endosulfan, *Crabs, *Hemocyanin, *Water pollution effects, *Lethal limits, *India, Spectrophotometry, Hydrogen ion concentration, Copper, Oxygen, Carbon dioxide, Scholander-Roughton analyzer, Crustaceans.

The toxic effects of endosulfan on the transport property of crab hemocyanin were examined. Two batches of six crabs each were exposed for 96 h to sublethal and lethal concentrations of endosulfan, respectively. After exposure, hemolymph was drawn from the base of the fourth walking leg with a syringe. Copper content was estimated using a spectrophotometer. Oxygen equilibrium curves (OECs) were determined at 580 nm. Absorption of oxyhaemocyanin was measured at various pressures and OECs were plotted. Hemolymph pH was measured with a pH meter. Carbon dioxide content was determined through gas extraction in a vacuum. Tests showed there was a significant increase in hemolymph copper concentration upon sublethal exposure, a significant decrease upon lethal exposure indicating an increase in hemocyanin upon sublethal exposure, and a decrease upon lethal exposure. There was a drastic decrease in hemolymph copper--and as such hemocyanin--concentration upon exposure to lethal concentrations of endosulfan. The OECs of crabs exposed to sublethal and lethal concentrations shifted to the right. Correspondingly, there was an increase in partial pressure of oxygen at which 50% of the hemocyanin is in oxygenated state and a decrease in degree of interaction among oxygen combining sites of the hemocyanin molecule at sublethal and lethal exposures, respectively. This indicates a decrease in the affinity of oxygen for the pigment. There exists a double-edged mechanism of enhancing hemocyanin synthesis and decreasing the affinity of oxygen for the pigment to increase crab survival after exposure to sublethal concentrations of endosulfan. (Main-PTT)
W88-00077

IMPACT OF CHRONIC LEAD POISONING ON THE HEMATOLOGICAL AND BIOCHEMICAL PROFILES OF A FISH, BARBUS CONCHONIUS (HAM),
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
H. Tewari, T. S. Gill, and J. Pant.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 748-752, May 1987. 1 tab, 19 ref.

Descriptors: *Lead, *Toxicity, *Heavy metals, *Fish, *Hematology, *Biochemical tests, *Tissue analysis, *Water pollution effects, Cholesterol, Blood glucose, Glycogen, Drinking water, Mining, Anemia, Basophilic stippling, Muscular atrophy, Lordoscoliosis.

The effects of chronically administered sublethal levels of inorganic lead on the hematological and biochemical profiles of Barbus conchonius were studied. Test Group I and II were submitted to 47.4 micrograms Pb(2+)/L as nitrate salt for 30 and 60 days, respectively. Routine hematological procedures were followed for erythrocyte count, and Hb Hct estimations. Photometric methods were used to evaluate blood and tissue cholesterol. Results showed considerable influence of chronic lead exposure on the peripheral blood and metabolite levels of Barbus conchonius: erythrocyte counts decreased 18.8 and 23.6%, respectively; there was a reduction in Hb accompanied by a lowering of Hct values; and mean corpuscular volume was reduced. Lead induced biochemical alterations included hyperglycemic response at both 30 and 60 days when the respective blood glucose values were 54.4 and 41.8% higher than the control values. A reduction in circulating and tissue levels of cholesterol was observed. (Main-PTT)
W88-00078

VARIATION IN ADENYLATE ENERGY CHARGE AND PHOSPHOADENYLATE POOL SIZE IN ESTUARINE ORGANISMS AFTER AN OIL SPILL,
North Carolina Univ. at Wilmington. Dept. of Biological Sciences.
T. H. Shafer, and C. T. Hackney.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 753-761, May 1987. 4 fig, 25 ref.

Descriptors: *Adenylate energy, *Phosphoadenylate, *Estuarine organisms, *Oil spills, *Water pollution effects, *Cape Fear River, *North Carolina, *Estuaries, *Clams, *Crabs, *Marsh grasses, Lyophilization, Enzymatic conversion, Luciferin, Tissue analysis, Diesel oil, Seasonal variations.

After a June 1983 tanker spill of number six diesel oil in the Cape Fear River, North Carolina, oil covered the tidal marshes on the east side of the river. The effects of the spill on adenylate energy charge (AEC) and total phosphoadenylate pool (TPP) in five test species were examined for up to a year. AEC and TPP values of the organisms were compared between contaminated and uncontaminated sites at all seasons. The five species collected were Polymesoda caroliniana, Uca minax, Juncus roemerianus, Spartina alterniflora, and S. cynosuroides. Tissue samples underwent lyophilization, extraction in ethylenediamine tetraacetic acid, and enzymatic conversion of ADP and/or AMP to ATP. ATP was quantified by the bioluminescence of luciferin, and the AEC was calculated. Long-term changes in AEC may result from sublethal stress due to oil pollution in some tidal marsh plants and animals but not in others, and TPP is not a more sensitive nor a more universal monitor of stress than AEC itself. (Main-PTT)
W88-00079

EFFECT OF VOLATILE HALOCARBONS ON LYMPHOCYTES AND CELLS OF THE URINARY TRACT,
Turku Univ. (Finland). Dept. of Public Health.
R. Kroneld.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 856-861, May 1987. 2 tab, 17 ref.

Descriptors: *Volatile halocarbons, *Lymphocytes, *Urinary tract, *Uroepithelial cells, *Human physiology, *Water pollution effects, Cytology, Cell cultures, Thymidine, Phytohaemaglutinine, Carcinogens, Tiohalomethanes.

The in vitro effects of volatile halocarbons, shown to exist in drinking water and body fluids, on lymphocyte stimulation and surface properties of cells of the urinary tract are considered. Human peripheral blood lymphocytes were cultured and then stimulated with 10 micrograms/ml phytohemaglutinine (PHA). After three days 10 microliters labelled thymidine was added to all the lymphocyte cultures and the uptake of 3H-thymidine was measured. Inhibition of stimulation was determined and the concentrations of the volatile halocarbons were measured by gas chromatography and electron capture detection analysis. Human uroepithelial cells were subjected to volatile halocarbons. The viability of the cells was monitored over time. The uroepithelial cells were subsequently tested for receptivity to bacteria. Volatile halocarbons reduced the PHA stimulation in lymphocyte cultures, and decreased viability of the uroepithelial cells. Both the PHA lymphocyte stimulation and the viability of uroepithelial cells were altered at the lowest concentrations of volatile halocarbons tested. The receptivity of human uroepithelial cells to bacteria was not altered by the test concentrations. (Main-PTT)
W88-00083

GENETIC AND BIOCHEMICAL EFFECT OF DRY RESIDUE OF ARNO RIVER IN VITRO AND IN VIVO,
Consiglio Nazionale delle Ricerche, Pisa (Italy). Ist. di Mutagenesi e Diffenziamento.
M. Paolini, C. Corsi, C. Bauer, R. Nieri, and R. Del Carratore.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 899-906, May 1987. 4 tab, 11 ref.

Descriptors: *Water pollution effects, *Toxicity, *Arno River, *Genetic toxicity, *Florence, Italy, Genetic studies, Fungi, Mice, Heavy metals, Mouse liver, Mouse lungs, Mouse kidney, Tissue analysis, Atomic absorption spectrophotometry, Cancer.

The ability of dry residue water of the Arno River to induce in vivo and in vitro genetic alterations in Saccharomyces cerevisiae and in vivo effects on the microsomal mono-oxygenase system of mouse liver were investigated. S. Cerevisiae strain D7 was used to measure the frequency of mitotic gene conversion at the trp locus, mitotic recombination between the centromere and the ade 2 locus and point mutation at the ilv locus. Mice were exposed to dry residue by gavage. The liver, lungs, and kidneys were analyzed separately for Cr, Mn, Cd, Cu, Ni, Zn, and Pb by atomic absorption spectrophotometry. In S. cerevisiae a significant increase of point mutation and mitotic gene conversion occurred. The ilv reversion frequency showed an increase at the 40 mg dose and at the highest dose. Gene conversion at the trp locus was less sensitive. After multiple treatment, only weak genetic effects were seen in the yeast recovered from the liver, lungs, and kidneys of treated mice. A marked increase in mice of aminopyrine N-demethylation was observed. The higher percent of induction clearly indicates co-toxic and co-mutagenic effects of dry residue of Arno water as well as in vitro genotoxic effects. (Main-PTT)
W88-00084

DIFFERENTIATION OF PHYSICAL FROM CHEMICAL TOXICITY IN SOLID WASTE FISH BIOASSAYS,

E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman, J. D. Popham, J. Griffin, D. Leslie, and J. Michaelson.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 3/4, p 295-308, April 1987. 5 fig, 2 tab, 16 ref.

Descriptors: *Toxicity, *Physical toxicity, *Chemical toxicity, *Solid wastes, *Fish, *Bioassays, *Water pollution effects, *Rainbow trout, Leaching, Centrifugation, Tissue analysis, Aluminum smelting wastes, Sludge, Dust, Solid waste disposal.

Tests were conducted to determine if particulate, rather than chemical toxicity, can cause fish mortality in bioassays. Test results showed that particulate toxicity was responsible for rainbow trout deaths in bioassays with two separate solid wastes. This conclusion was based on: (1) fish necropsies which indicated physical damage to gills but no evidence of chemical damage to liver or kidney; (2) chemical analyses which indicated levels of priority pollutants and other target compounds were too low to cause the observed toxicity; (3) structural and chemical analyses of the waste particles which showed that these consisted of inert materials; and (4) the use of centrifugation techniques to remove most of the suspended particulate material in bioassay tanks resulting in an elimination of most of the toxicity. The particles associated with the lethal effects were 5-10 micrometers in size. Regulatory testing of solid wastes must distinguish physical and chemical toxicity since disposal options can vary depending on the mode of toxicity. For instance, chemical toxicity raises concern regarding leaching through soils into groundwater, whereas if physical particles are responsible for toxicity, such leaching is not of concern. (Author's abstract)
W88-00098

WATER SUPPLIES AND SANITARY FACILITIES IN RURAL TRANSKEI,

Department of Health and Welfare, Umtata (South Africa). Epidemiological Unit.
N. N. Tshibangu.
South African Medical Journal, Vol. 71, No. 6, p 368-369, March 1987. 8 ref.

Descriptors: *Cholera, *Water supply, *Sanitary facilities, *Surface waters, *Water storage, *Water treatment, *Water pollution effects, Laboratory tests, Water use, Toilets, Pit latrines, Sanitary landfills, Human diseases, Public health, epidemiology.

Between October 1982 and September 1983, an outbreak of cholera occurred in Transkei. A total of 678 patients with clinical illness were reported in a review of positive laboratory results. Subsequent to each report, the health department personnel began a rigorous contact-tracing process during which data on the environment were collected. A total of 1157 standardized forms listing 6615 persons were returned to the Epidemiological Unit. Of these respondents, 87.2% reported having no sanitary facilities available, and 96.4% no refuse disposal site. Rivers, wells, springs, streams, dams, and stagnant pools were recorded as the main sources of water supply in the study area. (Author's abstract)
W88-00100

COMMUNITY OUTBREAK OF ADENOVIRUS TYPE 7A INFECTIONS ASSOCIATED WITH A SWIMMING POOL,

Oklahoma State Dept. of Health, Oklahoma City. Epidemiology Service and Lab. Service.
M. Turner, G. R. Istre, H. Beauchamp, M. Baum, and S. Arnold.
Southern Medical Journal SMJOAV, Vol. 80, No. 6, p 712-715, June 1987. 1 fig, 1 tab, 8 ref.

Descriptors: *Human diseases, *Swimming pools, *Adenovirus, *Water pollution effects, *Oklahoma, Chlorination, Pharyngitis, Viruses.

In July 1982, an outbreak of pharyngitis caused by adenovirus type 7a occurred among children in a town in western Oklahoma. Predominant symptoms were fever and sore throat, headache, abdominal pain, and conjunctivitis. At least 77 persons were identified whose symptoms met the case definition for illness. Onsets of illness peaked during the week of July 5-12, and the outbreak resolved within three weeks. A systematic telephone survey of the town revealed that persons who had swum at the community swimming pool were more likely to be ill than those who had not. A second survey of families with season passes to the pool showed that among swimmers, illness was directly related to average number of hours of exposure to the pool each week. In addition, swimmers who reported swallowing pool water were more likely to be ill than persons who did not. Throat-swab specimens from five of seven ill persons grew adenovirus 7a compared with one of 12 well persons. The pool chlorinator had reportedly malfunctioned during early July. The outbreak resolved with proper operation of the chlorination system. Swimming pools continue to be a potential source of community-wide outbreaks of adenovirus infections. (Author's abstract)
W88-00102

CUMULATIVE EFFECTS OF SIMULATED ACID RAIN ON SOIL CHEMICAL AND MICROBIAL CHARACTERISTICS AND CONIFER SEEDLING GROWTH,

California Univ., Berkeley. Dept. of Plant and Soil Biology.
J. G. McColl, and M. K. Firestone.
Soil Science Society of America Journal SSJD4, Vol. 51, No. 3, p 794-800, May-June 1987. 5 fig, 4 tab, 35 ref.

Descriptors: *Acid rain, *Soil chemistry, *Soil microbial characteristics, *Conifers, *Seedling growth, *Soil acidification, Forest soils, Microbial assays, Soil depth, Hydrogen ion concentration, Foliar damage, Douglas-fir, Sugar pine, Ponderosa pine, Carbon dioxide evolution, Microbial biomass, Exchangeable cations, Denitrification potential, Nitrification potential, Leaching, Sierra Nevada, Trace metals.

Effects of simulated acid rain treatments of HNO3 and H2SO4 were tested on seedlings of Douglas-fir, sugar pine, and ponderosa pine growing in A-horizon sample of two forest soils. Two wet periods of 34 and 37 weeks, separated by a dry period of 18 weeks simulated climatic conditions common in the Sierra Nevada, California. Representative results are presented for soils supporting Douglas-fir and for growth and shoot-N of all three species. Effects differed between soils but were usually increased from one wet period to the next and markedly decreased with soil depth. Effects commonly appeared in the pH 3.0 treatment only. Little or no effects were noted for seedling growth, visual symptoms of foliar damage, N concentration in shoots, or for the general soil microbial assays of CO2 evolution and microbial biomass. There were notable decreases in exchangeable cations and soil pH, and increases in soil Al, Mn, Fe, and Zn. Effects on N transformations in soil were inconsistent, but in the pH 3.0 treatment there were some significant increases in mineralizable N and denitrification potential and decreases in nitrification potential. (Author's abstract)
W88-00108

WATER-CONTACT PATTERNS AND SOCIOECONOMIC VARIABLES IN THE EPIDEMIOLOGY OF SCHISTOSOMIASIS MANSONI IN AN ENDEMIC AREA IN BRAZIL,

Universidade Federal de Minas Gerais, Belo Horizonte (Brazil). Dept. de Medicina Preventativae Social.
M. F. F. Lima E Costa, M. H. A. Magalhaes, R. S. Rocha, C. M. F. Antunes, and N. Katz.
Bulletin of the World Health Organization BWHOA6, Vol. 65, No. 1, p 57-66, 1987. 4 fig, 3 tab, 35 ref.

Descriptors: *Epidemiology, *Schistosomiasis, *Water-contact diseases, *Public health, *Water pollution effects, *Human diseases, *Brazil, Comercinho, Socioeconomic variables, Splenomegaly, Diseases.

A study was carried out in Comercinho in southeast Brazil where information relating to socioeconomic factors and water contacts was obtained from 290 (99% of the total) households and 1208 (82% of the total) inhabitants, respectively. Stool and physical examinations were performed on 90% and 82% of the population, respectively. The rates of Schistosoma mansoni infection and splenomegaly were higher in families whose heads were manual workers, in individuals living in houses without piped water and of poor construction, and in those who were born in Comercinho. A total of 1017 (84%) individuals reported water contact; 75% of these contacts were for household activities or bathing and 21% for leisure. The fecal egg counts decreased in persons over 15 years of age, while the degree (intensity) of water contact did not. The mean degree of water contact was higher in individuals without than with piped water in the household (96.8+-0.6 v. 25.7+-0.6). The main risk factors for splenomegaly were no piped water, intense water contact, bathing in streams, and daily contact (odds ratio=7.3,5.1,4.5 and 3.6, respectively). These results indicate that the extension of piped water to houses should decrease the incidense of splenomegaly in this endemic area. (Author's abstract)
W88-00114

PHYSIOLOGICAL STRESS INDUCED BY SUBLETHAL CONCENTRATIONS OF PHENOLIC COMPOUNDS IN NOTOPTERUS NOTOPTERUS: MEASUREMENT OF HYDROLYTIC ENZYMES,

Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
S. Gupta.
Environmental Research ENVRAL, Vol. 42, No. 2, p 304-311, April 1987. 3 tab, 17 ref.

Descriptors: *Water pollution effects, *Fish, *Toxicity, Stress, Physiological stress, Phenols, Hydrolytic enzymes, Tissue analysis, Enzymes.

The studies on the effects of phenol (P), 2,4-dinitrophenol (DNP), pentachlorophenol (PCP) individually and in three combinations, namely (PCP + DNP)/P (highly antagonistic); (DNP + P)/PCP (additive), and (P + DNP)/PCP (highly synergistic), at three sublethal levels (1/10, 1/15,

and 1/20 of the 96-hr LC50) on the activty of hydrolytic enzymes (acid, alkaline, and glucose-6-phosphates and 5-nucleotidase) in the brain and kidney of a freshwater teleost, Notopterus notopterus revealed inhibition of enzyme activity after 15 and 30 days of exposure. Maximum inhibition (-89.32%) was observed in acid phosphatase activity in brain at 1/10 concentration of (P + DNP)/PCP combination after 30 days, but minimum (-3.64%) in activity of glucose-6-phosphates in kidney at 1/20 of (PCP + DNP)/P combination following 15 days of exposure. However, biphasic effects of P, DNP, and (PCP + DNP)/P combination were observed in kidney, i.e., inhibition of enzyme activity at higher concentrations and stimulation at lower concentrations after both time intervals. (Author's abstract)
W88-00116

STAGE SENSITIVITY OF EGGS OF THE TELEOST ORYZIAS LATIPES TO CADMIUM EXPOSURE,
Toyama Univ. (Japan). Biological Inst.
H. Michibata, Y. Nojima, and M. K. Kojima.
Environmental Research ENVRAL, Vol. 42, No. 2, p 321-327, April 1987. 3 fig, 25 ref.

Descriptors: *Fish eggs, *Cadmium, *Water pollution effects, Trace elements, Trace metals, Mortality.

The stage sensitivity of eggs of the teleost Oryzias latipes to cadmium exposure was examined. First, using eggs at the blastula stage, the proper concentration of cadmium to which the eggs should be exposed was estimated. The eggs were exposed to cadmium solutions ranging from 10.0 to 300.0 mg Cd/liter for 1 hr, and then they were transferred to cadmium-free medium. The cumulative mortality of the eggs was estimated by counting dead eggs within 24 hr. Mortality (1.1 + or - 0.7%) indistiguishable from that of the control (1.0 + or - 0.2%) was obtained in the solution of 10.0 mg Cd/liter. Relatively higher mortalities of 13.2 + or - 1.5, 18.0 + or - 1.0, and 20.7 + or - 3.1% could be seen in the solutions containing 50.0, 100.0, and 150.0 mg Cd/liter, respectively. The exposure of the eggs to 200.0 and 300.0 mg Cd/liter increased mortality rates to 32.0 + or - 0.8 and 34.7 + or - 2.4%, respectively. Consequently, the concentration of 200.0 mg Cd/liter was selected for examining the stage sensitivity. Eggs at 11 different developmental stages were exposed to cadmium at a concentration of 200.0 mg Cd/liter for 1 hr. The mortalities obtained at the 4- to 16-cell stage, 32-cell stage, and morula stage were 99.2 + or - 1.0, 97.4 + or - 2.6, and 89.6 + or - 10.6%, respectively. With the progress of embryonic development, the eggs became increasingly resistant to cadmium toxicity. After the morula stage, the mortalities decreased abruptly. In order to ascertain whether the change in mortalities of the eggs with development was related to the amount of cadmium combined with the eggs, the cadmium content was determined. In contrast to the remarkable change in the sensitivity to cadmium, the curve of cadmium content in the eggs remained constant at about 520 ng/egg throughout the experimental period. (Author's abstract)
W88-00118

EVALUATION OF TOXICITY LIMIT AND SEX HORMONE PRODUCTION IN RESPONSE TO CYTHION AND BHC IN THE VITELLOGENIC CATFISH CLARIAS BATRACHUS,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
S. Singh, and T. P. Sigh.
Environmental Research ENVRAL, Vol. 42, No. 2, p 482-488, April 1987. 2 tab, 24 ref.

Descriptors: *Chlorinated hydrocarbons, *Water pollution effects, *Pesticides, *Fish, *Toxicity, *Organophosphorus pesticides, Sex hormones, Hormones, Catfish, Vitellogenic catfish, Cythion, Organochlorine, Water pollution effects, Pesticides.

The impact of cythion (organophosphorous) and BHC (organochlorine) on survival and the effects of their sublethal concentrations on plasma levels of testosterone, estradiol-17B and estrone were assessed in the female catfish Clarias batrachus. Initial median lethal concentrations (LC(I)50) for 96 hr of exposure to cythion and BHC were recorded as 12 and 16 ppm, respectively. Their sublethal concentrations (SL) for the same period of exposure were 7 and 12 ppm. The 96-hr safe concentrations (SC) was 1 ppm for cythion and 2 ppm for BHC. Longer exposure to four weeks brought down the SL concentration to 4 and 8 ppm for cythion and BHC, respectively, but no change was observed in SC. Sublethal concentrations of either pesticide apparently affected sex hormone production after 4 weeks of exposure, as was evident by decreased levels of sex hormpones in blood plasma. Both pesticidee caused greater reduction in plasma sex hormone levels at SL concentrations than at SC. The magnitude of inhibition of testosterone and esradiol-17B levels at either concentration was alike for both pesticides, but estrone levels were highly affected by BHC compared to cythion. Thus, it might be inferred that cythion and BHC toxicity affected sex hormone production due to the impairment in the synthesis and/or release of the steroids. (Author's abstract)
W88-00119

SENSITIVITY OF EARLY LIFE STAGES OF BLUEBACK HERRING TO MODERATE ACIDITY AND ALUMINUM IN SOFT FRESHWATER,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
R. J. Klauda, R. E. Palmer, and M. J. Lenkevich.
Estuaries ESTUDO, Vol. 10, No. 1, p 44-53, March 1987. 3 fig, 4 tab, 48 ref. DNR Contract No. PR 85-066-02.

Descriptors: *Water pollution effects, *Herring, *Acidic water, *Aluminum, *Acid rain, Pollutants, Fish, Acidity, Sublethal effects, Mortality, Lethal limit, Fish embryos, Hydrogen ion concentration, Toxicity, Chesapeake Bay, Maryland.

The sensitivity of the blueback herring Alosa aestivalis to acidity and aluminum (Al) in reconstituted, soft freshwater (23-25 milligrams/liter (mg/l) hardness as CaCO3) was investigated in a continuous exposure laboratory study. Mature (20-24 hours postfertilization) embryos were more tolerant than 1- to 5-day-old yolk-sac larvae. Significant mortality of embryos occurred only when pH was 5.0 and the total Al concentration was 0.42 mg/l (predicted MIBK-extracted total monomeric Al = 0.34 mg/l). Moderate acidity dramatically decreased the survival of yolk-sac larvae. Mean mortality was 99% in pH 5.0 and 89% in pH 5.7 compared to 38% in pH 6.5 and 16% in pH 7.8 without Al. The toxicity of Al to yolk-sac larvae was pH- and dose-dependent. Total Al concentrations up to 0.34 mg/l (predicted total monomeric Al up to 0.21 mg/l) were not toxic at pH 6.5 and 7.8. At pH 5.0 and 5.7, Al increased the rate at which yolk-sac larvae died during a 96-hour exposure (i.e., time to 50% mortality decreased with increasing Al). Continuous exposure to a predicted total monomeric Al level of only 0.03 mg/l at pH 5.0 killed all yolk-sac larvae in <24 hours. The mechaniams of acid and Al toxicity were apparently physiological and not associated with extensive cellular damage. Acidification events measured in Chesapeake Bay tributaries may reduce survival of blueback herring yolk-sac larvae and embryos exposed to those events. (Author's abstract)
W88-00138

MERCURY-BINDING PROTEINS IN THE SLIPPER LIMPET, CREPIDULA FORNICATA, EXPOSED TO INCREASED SOLUBLE MERCURY,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W88-00142

SHELLFISH-ASSOCIATED ENTERIC VIRUS ILLNESS IN THE UNITED STATES, 1934-1984,
National Marine Fisheries Service, Charleston, SC. Southeast Fisheries Center.
G. P. Richards.
Estuaries ESTUDO, Vol. 10, No. 1, p 84-85, March 1987. 1 fig, 14 ref.

Descriptors: *Water pollution effects, *Enteroviruses, *Shellfish, *Human diseases, Wastewater, Pollutants, Viruses, Diseases, Coastal waters, Regulations, Coliforms, Pathogens.

The regulation of shellfish and their growing waters is based on total and fecal coliform standards. Application of these standards has reduced the incidence of shellfish-borne bacterial illnesses in humans, but outbreaks of viral diseases, such as hepatitis A, Norwalk illness, and viral gastroenteritis, prevail. Hepatitis A virus contributed to 1,395 cases of shellfish-associated illness since 1961. An additional 6,049 cases of shellfish-associated gastroenteritis were reported over the past 50 years, 75% of which (4,609 cases) occurred since 1980. The number of reports of disease outbreaks may further increase as better reporting practices are initiated by health professionals and state and federal agencies. It is feared that if this trend continues, public apprehension concerning the safety of consumption of shellfish may affect the economic stability of the shellfish industry and ultimately result in the loss of a food source. Actions necessary to reduce the incidence of shellfish-associated viral illness include development of methods for detecting viral pathogens in shellfish and harvest waters, correlation of levels of viral pathogens with potential viral and bacterial indicators, and acceleration of field monitoring and enforcement efforts. (Wood-PTT)
W88-00143

EPIDEMOLOGY OF INFECTION BY NONTUBERCULOUS MYCOBACTERIA VII. ABSENCE OF MYCOBACTERIA IN SOUTHEASTERN GROUNDWATERS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
E. C. Martin, B. C. Parker, and J. O. Falkinham.
American Review of Respiratory Disease ARDSBL, Vol. 136, No. 2, p 344-348, August 1987. 1 fig, 2 tab, 17 ref. National Institute of Allergy and Infectious Disease Grant No. AI-13813.

Descriptors: *Mycobacteria, *Human diseases, *Infection, *Groundwater pollution, *Southeastern United States, *Epidemiology of infection, Georgia, Virginia.

Using the fluorochrome auramine-O, direct microscopic counts of log phase cells of mycobacteria group should excellent correlation with viable spread-plate counts. Accordingly, an enumeration of total acid-fast and bacteria cells by stain and culture (respectively) in groundwaters from three United States regions that differ in their incidence of human infection by mycobacteria was undertaken. Of 30 state monitored, undisinfected wells, 11 were in the Georgia coastal plain (high incidence), 10 were in the Virginia costal plain (intermediate incidence), and 9 were in Montgomery county, Virginia (low incidence). Total acid-fast cells ranged widely between 280 to 5,367 per ml among the groundwaters, and with one exception showed no correlation or trends between regions of different incidence of human infection, or to total bacterial counts or colony-forming units. The exception was that the proportions of acid-fast cells relative to total cells were higher in the Georgia groundwaters. However, despite the relatively high auramine-O counts, few mycobacteria were recovered by culture. Of 12 wells yielding mycobacteria, 9 yielded rapidly growing and 4 slowly growing mycobacteria. Only one well in Montgomery County, Virginia (region of low incidence) yielded a mycobacteria isolate, albeit at low density. This research supports the conclusion that clean groundwaters are unlikely sources of mycobacteria infection in humans in the southeastern United States. (Author's abstract)
W88-00152

SNOW MOUNTAIN AGENT GASTROENTERITIS FROM CLAMS,
Centers for Disease Control, Atlanta, GA. Div. of

Field Services.
B. I. Truman, H. P. Madore, M. A. Menegus, J. L. Nitzkin, and R. Dolin.
American Journal of Epidemiology AJEPAS, Vol. 126, No. 3, p 516-525, September, 1987. 2 fig, 2 tab, 43 ref.

Descriptors: *Clams, *Human diseases, *Gastroenteritis, *Norwalk agent, *Viral diseases, Snow Mountain agent, Wastewater, Water pollution effects, Municipal wastewater.

A 1983 investigation of two clambake-related gastroenteritis outbreaks in Rochester, New York, showed that 43% of 196 persons interviewed had an acute illness characterized by watery diarrhea, vomiting, and abdominal cramps. Illness was associated with eating raw or baked hard-shell clams, with the risk of illness increasing with the total number of clams consumed. Stool samples obtained 2-4 days after onset of illness were negative for commonly recognized bacterial and viral pathogens. However, of 31 persons whose stools were tested, the stool of only one ill person was positive by enzyme-linked immunosorbent assay for the Snow Mountain agent, one of the Norwalk-like viruses. Paired serum specimens from six of nine ill and two of seven well persons showed a fourfold or greater rise in antibody titer to Snow Mountain agent. Persons who ate clams were more likely to seroconvert to Snow Mountain agent than were those who did not eat clams. The clams were harvested off the coast of southern Massachusetts in late October, when harvest waters were documented to be contaminated by untreated municipal sewage. This is the first documented outbreak of shellfish-associated gastroenteritis attributed to Snow Mountain agent. (Ray-PTT)
W88-00153

WATERBORNE OUTBREAK OF LEPTOSPIROSIS,
Istituto Superiore di Sanita, Rome (Italy).
B. Cacciapuoti, L. Ciceroni, C. Maffei, F. Di Stanislao, and P. Strusi.
American Journal of Epidemiology AJEPAS, Vol. 126, No. 3, p 535-545, September 1987. 2 fig, 6 tab, 35 ref.

Descriptors: *Leptospirosis, *Water pollution sources, *Human diseases, *Water pollution, Drinking water, Italy, Public health.

During the period July 10-26, 1984, 33 cases of serologically confirmed leptospirosis occurred in a small town in central Italy. The fatality rate, including the deaths of two unconfirmed cases, was 8.6%. Based on serological evidence, the infection was caused by leptospires of the serogroup Australis. Epidemiological study showed that the patients contracted the infection by drinking water from a fountain. The source of leptospiral contamination was probably a hedgehog trapped in a reservoir of water not in use but still connected to the water system of the fountain. (Authors' abstract)
W88-00154

AQUATIC COLEOPTERA AND HEMIPTERA IN SOME CANADIAN SALINE LAKES: PATTERNS IN COMMUNITY STRUCTURE,
British Columbia Univ., Vancouver. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-00162

ALGAE AS ECOLOGICAL INDICATORS,
North Dakota Univ., Grand Forks. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-00196

INDICATOR ALGAL ASSAYS: LABORATORY AND FIELD APPROACHES,
Connecticut Univ., Storrs. Biological Sciences Group.
For primary bibliographic entry see Field 5A.
W88-00197

IN SITU AND NATURAL PHYTOPLANKTON ASSEMBLAGE BIOASSAYS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5A.
W88-00198

QUALITATIVE CHARACTERISTICS OF PHYTOPLANKTON ASSEMBLAGES,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5A.
W88-00199

ALGAL ASSAYS FOR VITAMINS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W88-00200

USE OF SEAWEEDS FOR MONITORING COASTAL WATERS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5A.
W88-00201

EFFECT OF ENVIRONMENTAL CONTAMINANTS ON AQUATIC ALGAE,
Columbia National Fisheries Research Lab., MO.
T. P. Boyle.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 237-256, 8 tab, 100 ref.

Descriptors: *Pollutants, *Algae, Bioaccumulation, Ecological effects, Aquatic plants, Aquatic productivity, Algal growth, Water pollution effects.

The presence of chemical contaminants has been a pervasive threat to many types of natural aquatic ecosystems. Some primary and secondary responses of algae to a variety of contaminants are reviewed. Adverse impacts include action of contaminants on a number of cellular and biochemical processes critical to algal growth and production, such as photosynthesis, nucleic acid production, protein and lipid biosynthesis, uptake of nutrients, and nitrogen fixation. Secondary impacts of toxicity of contaminants include reduction of zooplankton grazers, which results in altered algal community structure. Algae taken up and bioconcentrate a variety of environmental contaminants. Algae have also been implicated in the degradation of organic contaminants, apparently by acting directly in the degradation or by mediating photolysis. Thus, algae may be an important factor in the mitigation of contaminant effects on other organisms by sorption or rendering the toxic chemical unavailable by degradation to a harmless form. (See also W88-00196) (Halterman-PTT)
W88-00202

ALGAE AS MONITORS OF HEAVY METALS IN FRESHWATERS,
Durham Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 5A.
W88-00203

UTILIZATION OF ALGAL CULTURES AND ASSAYS BY INDUSTRY,
Minnesota Mining and Mfg. Co., St. Paul. Environmental Lab.
For primary bibliographic entry see Field 5A.
W88-00204

ALGAL BIOASSAYS OF INDUSTRIAL AND ENERGY PROCESS EFFLUENTS,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5A.
W88-00205

SYNTHETIC MICROCOSMS AS BIOLOGICAL MODELS OF ALGAL COMMUNITIES,
Washington Univ., Seattle. Coll. of Ocean and Fishery Sciences.
F. B. Taub.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 363-394, 9 fig, 2 tab, 37 ref.

Descriptors: *Algae, *Microcosm studies, *Model studies, Ecological effects, Aquatic plants, Aquatic productivity, Algal growth, Zooplankton, Protozoa, Water pollution effects, Pollutants.

Microcosm studies have been widely used to analyze a variety of environmental interactions. This paper reports on studies performed in developing and testing the responses of algal microcosms to a variety of toxic chemicals. The microcosms, one-gallon glass wide-mouth bottles, were inoculated with several species of algae, followed by inoculation four days later with zooplankton and protozoa. The effects of concentration of the algae growth medium, responses of assemblages to streptomycin, and the response to malathion were measured. Diluting the medium 1/10 resulted in decreased values of functional attributes associated with primary production, such as daytime oxygen change, in vivo fluorescence, and pH. Daphnia populations were very small in the dilute medium. Finally, in the dilute medium, most algae become very rare over time, with the exception of Ankistrodesmus and filamentous algae. The addition of streptomycin altered many ecological processes such as reduction in algal abundance, delayed nutrient depletion, reduced fluorescence, and reduced extracted chlorophyll levels. Malathion caused massive kills of the grazers, allowing the algae to grow. When grazers were reintroduced after seven days, they were able to survive, indicating that the malathion had broken down. (See also W88-00196) (Halterman-PTT)
W88-00206

SIMULATING THE EFFECTS OF INCREASED TEMPERATURE IN A PLANKTON ECOSYSTEM: A CASE STUDY,
Washington Univ., Seattle. Center for Quantitative Science.
V. H. Dale, and G. L. Swartzman.
IN: Algae as Ecological Indicators, Academic Press, New York, 1984. p 395-427, 13 fig, 4 tab, 44 ref. Contract No. NRC 04-75-222.

Descriptors: *Model studies, *Thermal pollution, *Thermal stress, *Algae, *Zooplankton, Ecological effects, Aquatic productivity, Algal growth, Phytoplankton, Plankton.

Simulation experiments are useful in assessing the role of a given process or organism in model dynamics by examination of model behavior under several alternative hypotheses. Simulations are also useful if it is not possible or advisable to actually manipulate the ecosystem. This paper presents a simulation study which assesses the effects of increased temperature on a plankton ecosystem in Lake Ontario. The model included growth and loss for phytoplankton, herbivorous zooplankton, and carnivorous zooplankton. The effects of light, nutrients, temperature, and respiration on growth and loss were also included. Simulated increased temperatures predicted an early spring phytoplankton peak, which is limited by grazers. Also, more algae blooms occurred, and light became limiting during late summer. As a group, blue-green algae were found to be favorable in the thermally-loaded environment. (See also W88-00196) (Halterman-PTT)
W88-00207

MICROBIOLOGICAL HEALTH EFFECTS ASSOCIATED WITH THE USE OF MUNICIPAL WASTEWATER FOR IRRIGATION,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 3C.
W88-00283

TRACE METALS IN SOILS AND PLANTS RECEIVING MUNICIPAL WASTEWATER IRRIGATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3C.

W88-00285

WATER POLLUTION,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-00331

ECOSYSTEM APPROACH TO ENVIRONMENTAL MANAGEMENT,
Ecosystem Research Inst., Logan, UT.
For primary bibliographic entry see Field 6G.
W88-00353

POTENTIAL EFFECTS OF PROCESSED OIL SHALE LEACHATE IN THE AQUATIC ENVIRONMENT,
Utah Water Research Lab., Logan.
J. G. Dickson, M. L. Cleave, D. L. Maase, V. D. Adams, and D. B. Porcella.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 339-362, 2 fig, 5 tab, 42 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Oil shale, *Mine wastes, *Leachates, *Aquatic life, Saline water, Algae, Lake Powell, Organic compounds, Polyaromatic hydrocarbons, Aromatic hydrocarbons, Carcinogens, Mutagens, Sediments, Reservoirs.

The effects of oil shale leachates on aquatic organisms were determined in three studies. Sensitivity to salt addition occurred in the following order: Selenastrum (a standard test algae)>acclimated Selanstrum>Synedra (indigenous to Lake Powell)> the combined species. The level of salinity required to suppress the growth of Synedra was 0.05N NaCl (1150 m/L). However, costs to agricultural users would likely prevent salinity from reaching this level in the reservoir. Spent oil shale leachates stimulated Scenedesmus productivity more than raw shale leachates. Several polycyclic aromatic hydrocarbons (PAH), including several carcinogens, were identified in spent oil shale extracts. Up to 50 ppb of 4- and 5-ring PAHs were found in organic extracts; 10 micrograms/L or less, in the aqueous extracts. Ames testing showed that in most cases the mutagenic response was nonadditive, which may underestimate the total composition of mutagens/carcinogens in the ample. Exposure of a three-phase microcosm (reservoir sediment, synthetic media, and gaseous phase) showed that higher molecular weight PAHs persist in the aquatic sediments and biota. However, dissolved PAHs at concentrations up to 3 micrograms/L did not appear to change normal ecosystem structure or function during the 60-day test. Results also indicated that the higher molecular weight PAHs do not accumulate in the food chain. (See also W86-02484) (Cassar-PTT)
W88-00354

PROGNOSIS FOR WATER CONSERVATION AND THE DEVELOPMENT OF ENERGY RESOURCES AT THE SALTON SEA - DESTRUCTION OR PRESERVATION OF THIS UNIQUE ECOSYSTEM,
California State Dept. of Fish and Game, Chino. Chino Fisheries Base.
For primary bibliographic entry see Field 6G.
W88-00355

ECOLOGICAL STUDY OF THE AMOCO CADIZ OIL SPILL.
National Oceanic and Atmospheric Administration, Washington, DC.
Report of the NOAA-CNEXCO Joint Scientific Commission, October 1982. Edited by E.R. Gundlach and M. Marchand. 479 p.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Ecological effects, *Fate of pollutants, Microbial degradation, Marine sediments, Benthic fauna, Marsh plants, Biodegradation, Marine animals, Oysters, Mollusks, Fish, Environmental impact statement, Hydrocarbons, Salt marshes, Vegetation effects, Environmental effects.

Shortly after the oil spill of the AMOCO CADIZ (March 16, 1978) off the northwest coast of France, members of the National Oceanic and Atmospheric Administration and the French national oceanographic organization (CNEXO) conducted an investigation of the physical, biological, microbiological and chemicalmanifestations of the spill. The Joint Commission responsible for the studies identified the following as the most important areas for research: heavily iompacted subtidal areas like the Abers abd the Bays of Morlaix and Lannion, heavily impacted intertidal areas such as St. Efflam and the salt marsh at Ile grande, the detailed chemical evolution of the pertroleum hydrocarbons, and the biodegradation of petroleum. This report is a compilation of the results of these studied which spanned a 3-yr period. Topics examined include: microbial degradation; analytical techniques; hydrocarbon concentrations and distributions; and oil pollution effects on sediments, fauna, benthos, oysters, fish, and marine and marsh vegetation. (See W88-00364 thru W88-00372) (Geiger-PTT)
W88-00378

AMOCO CADIZ POLLUTANTS IN ANAEROBIC SEDIMENTS: FATE AND EFFECTS ON ANAEROBIC PROCESSES,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W88-00385

LONG-TERM IMPACT OF THE AMOCO CADIZ CRUDE OIL SPILL ON OYSTERS CRASSOSTREA GIGAS AND PLAICE PLEURONECTES PLATESSA FROM ABER BENOIT AND ABER WRAC'H, BRITTANY, FRANCE,
Battelle New England Marine Research Lab., Duxbury, MA.
J. M. Neff, and W. E. Haensly.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p 269-327, 33 tab, 36 ref.

Descriptors: *Water pollution effects, *Fish, *Oysters, *Oil pollution, *Ecological effects, *Fate of pollutants, Mollusks, Petroleum products, Oil, Hydrocarbons, Accumulation, Bioaccumulation, Stress, Toxicity.

Pathologies were found in the muscle, digestive gland, gut, gonad, gill, and mantle of oysters exposed to oil from the AMOCO CADIZ spill. There were no consisten differences in characteristics of the aliphatic hydrocarbon fraction between reference oysters and oysters from oil-polluted Aber Benoit and Aber Wrac'h. Whole fish and muscle samples of plaice contained low concentrations of aliphatic and aromatic hydrocarbons. Oysters contained high concentrations of alkanes, dominated by low molecular weight compounds, while in plaice, the dominant alkanes in liver samples were the higher molecular weight compounds. Several biochemical parameters (blood cholesterol/HDL chloesterol, liver ascorbic acid, and skeletal muscle-free amino acid ratios in fish and adductor muscle-free amino acid ratios in oysters) were evaluated as potential indices of pollutant stress from oil-contaminated Aber Benoit and Aber Wrac'h. Values of some of these parameters were statistically significantly different in populations from the oil-polluted Abers and from nearby reference stations. Aletrations in biochemical parameters in oil-polluted fish and oysters are indicative or symptomatic of poor nutritional status which may be related to histopathological lesions found in the gut and liver of plaice from the oil-contaminated Abers. The most prevalent pathologic lesion in oysters from Bittany was leucocytosis. (See also W88-00363) (Geiger-PTT)
W88-00386

RESTORATION OF MARSH VEGETATION IMPACTED BY THE AMOCO CADIZ OIL SPILL AND SUBSEQUENT CLEANUP OPERATIONS AT ILE GRANDE, FRANCE,
North Carolina State Univ. at Raleigh. Dept. of Botany.
E. D. Seneca, and S. W. Broome.
IN: Ecological Study of the AMOCO Cadiz Oil Spill, October 1982. p 363-419, 59 fig, 12 tab, 16 ref.

Descriptors: *Marshes, *Vegetationestablishment, *Marsh plants, *Oil pollution, *Revegetation, *Water pollution effects, Oil spills, Ecological effects, Salt marshes, Tidal marshes, Nutrients, Fertilizers, Spartina, Marsh management, Vegetation, Vegetation regrowth.

Experimental plantings of Halimione protulacoides, Juncus maritimus, Puccinellia maritima, Spartina maritima, and Triglochin maritima have been made at Ile Grande and Kerlavos, France to rehabilitate salt marsh impacted by the AMOCO CADIZ oil spill and subsequent cleanup operations. Spartina transplants survived at lower elevations than those of anoy other species tested, but the best growth of transplants of all species tested occurred within + or - 0.3 m of the elevation of the natural marsh in the vicinity. Transplants of Puccinelli with a core of root and substrate material intact (plugs) were superior to those transplants with roots only (sprigs). Both nitrogen and phosphorus were required for good transplant growth on the disturbed sites tested. Slow release fertilizer materials produced better growth over a wide range of substrate types than did conventional, more soluble fertilizer materials. Higher survival and better growth were obtained with Halimione and Ouccinellia transplants than with those of the other three species tested. Aboveground growth of the best experimental plants of Puccinnellia spread radially at the rate of about 10 cm annually. At this rate of spread, these experimental plantings would achieve complete substrate cover in about 3 yr after planning. Preliminary data indicate that other marsh plants invade experimentally planted areas more rapidly than they invade unplanted distrubed sites. (See also W88-00363) (Geiger-PTT)
W88-00387

OXIDIZED RESIN ACIDS IN DOUGLAS FIR WOOD EXTRACTIVES,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
For primary bibliographic entry see Field 5A.
W88-00430

HALOGENATED ORGANIC COMPOUNDS IN SPENT BLEACH LIQUORS: DETERMINATION, MUTAGENICITY TESTING AND BIOACCUMULATION,
Sentralinstitutt for Industriell Forskning, Oslo (Norway).
For primary bibliographic entry see Field 5A.
W88-00431

ANALYSIS OF TOXICITY AND BIODEGRADABILITY OF ORGANOCHLORINE COMPOUNDS RELEASED INTO THE ENVIRONMENT IN BLEACHING EFFLUENTS OF KRAFT PUMPING,
Helsinki Univ. (Finland). Dept. of General Microbiology.
For primary bibliographic entry see Field 5A.
W88-00432

IDENTIFICATION OF THE PARTIAL OXIDATION PRODUCTS FROM OZONATION OF HYDRAZINE, MONOMETHYL HYDRAZINE AND UNSYMMETRICAL DIMETHYL HYDRAZINE,
Catalytic, Inc., Philadelphia, PA.
For primary bibliographic entry see Field 5B.
W88-00439

CHEMICAL AND PHYSICAL PROPERTIES OF CONNECTICUT LAKES,
Connecticut Agricultural Experiment Station, New Haven.

C. R. Frink, and W. A. Norvell.
Bulletin 817, April 1984. 77 p, 8 fig, 4 tab, 42 ref, 4 app.

Descriptors: *Water pollution effects, *Lakes, *Eutrophication, *Nutrients, *Connecticut, Transparency, Phosphorus, Trophic level, Water quality, Chlorophyll, Algae, Nitrogen, Nonpoint pollution sources, Land use.

Water quality in 70 Connecticut lakes was analyzed during 1973-1980. Phosphorus is the element controlling algal growth in most lakes; nitrogen is seldom the limiting nutrient. Lake transparency is determined largely by algal growth; it is predicted from measurements of chlorophyll a and color. Historical data from 1937-1939 for 35 lakes show that total phosphorus and chlorophyll has increased in most lakes and transparency has decreased. Alkalinity has not changed significantly. Model predictions of phosphorus concentrations agree reasonably well with observed concentrations in a set of 33 lakes. Estimates of phosphorus export (in pounds/acre) from various land types were as follows: urban, 1.52; agricultural, 0.48; and wooded, 0.09. (Cassar-PTT)
W88-00467

EFFECTS FROM RESIDUAL AND NO. 2 FUEL OILS ON INTERTIDAL INFAUNA RECOVERY RATE.
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152298. Price codes: A03 in paper copy, A01 in microfiche. 1981. Final Report. 25 p, 7 tab, 14 ref.

Descriptors: *Oil pollution, *Oil wastes, *Water pollution, *Water pollution effects, Marine environment, Macroinvertebrates, Polychaetes, Crustaceans.

Studies are described which were conducted to provide a comparative measure of the chemical persistence in sediment of No. 2 fuel oil and residual fuel oil under controlled conditions in marine intertidal zone; and to provide a measure of the effects of these two oils on the recovery of intertidal infauna as compared to untreated control sediments. Results indicate that the two fuel oils differed in the severity of effects on early recovery of infauna, with No. 2 fuel oil being the most toxic. There was a significant effect on two species, the crustacean Leptochelia dubia and the polychaete Exogone lourei, which have been identified as being especially useful indicators of oil contamination effects. (Halterman-PTT)
W88-00476

ALABAMA MARINE LAW PROGRAM.
Mississippi-Alabama Sea Grant Consortium, Ocean Springs, MS.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152322. Price codes: A02 in paper copy, A01 in microfiche. MASCP-82-010, 1982. Final Report. 18 p. Contract No. NA81AA-D-00050.

Descriptors: *Marine law, *Sea grant, Legal aspects, Leases, Wetlands, Water use, Natural gas, Aquifers, Environment, Marine environment, Environmental management.

The Alabama Marine Law Program at the University of Alabama Law Center was funded from January 1, 1979 to May 31, 1982. During this period, the Program had as its continuing objective research, service and education in issues relating to law and the coastal/marine area. Major accomplishments of the program include: publication and distribution of the newsletter Update; establishment of a permit information center for the coastal area; preparation of the hearing draft for the Coastal Management Program; teaching the course 'Introduction to Coastal and Environmental Law' to graduate students in 1979, 1980, and 1981 through the Marine Environmental Sciences Consortium; publication and distribution of monographs on submerged land ownership, wetlands law, water use conflicts, state energy and environmental agencies, methane gas ownership, and thermal energy storage in aquifers; presentation of workshops and seminars on environmental issues and ocean law and policy; drafting of legislation prohibiting motor vehicle use on the dune areas; and a number of research projects for marine users. (Author's abstract)
W88-00477

DESCRIPTION AND ASSESSMENT OF THE RAFT RIVER LOTIC SYSTEM IN THE VICINITY OF THE RAFT RIVER GEOTHERMAL AREA,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
J. R. Barnes, and D. K. Shiozawa.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-014302. Price codes: A03 in paper copy, A01 in microfiche. DOE/ID/01674 -- TI, Annual Report, 1982. 47 p, 8 fig, 18 tab, 14 ref.

Descriptors: *Streams, *Fish, *Invertebrates, *Water pollution effects, Lotic environment, Baseline studies, Raft River, Idaho, Geothermal studies, Aquatic habitats, Habitats.

Baseline studies of the lotic system of the Raft River, Idaho, were conducted in order to predict the impact of a geothermal spill into the stream. Mean discharge varies from 246 L/sec in late summer to 1193 L/sec during the late spring snowmelt runoff. Seven species of fish, including the rare speckled dace and cuthroat trout, were collected. Both fish and invertebrates in this stream tend to migrate. The fish move out of the downstream sections in late summer and in fall, thus avoiding the harsh, freezing conditions in these shallower reaches. For some species the downstream sections are a nursery ground, where the young do not compete with adults. Seasonal factors and detritus pulses govern invertebrate movement. The effect of an isolated, short-lived geothermal spill is believed to be minimal. Although immature fish in the downstream reaches would be lost, most of the adults and some of the young in the upstream reach would survive. Invertebrates would recover through colonization by drifting organisms. (Cassar-PTT)
W88-00484

EVALUATION OF THE HEALTH RISKS OF ORDNANCE DISPOSAL WASTE IN DRINKING WATER.
National Research Council, Washington, DC. Assembly of Life Sciences.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-153635. Price codes: A04 in paper copy, A01 in microfiche. National Academy Press, Washington, DC. February 1982. 52 p, 12 tab, 127 ref. Contract No. N00014-80-C-0161.

Descriptors: *Water pollution, *Stream pollution, *Ordinance wastes, *Nitrates, Water pollution effects, Water pollution sources, Toxicity, Drinking water, Potable water, Public health aspects, Organic compounds.

Several constituents of ordnance disposal waste have been of concern as potential contaminants of drinking water. For five of these compounds, ammonium picrate, picramic acid (2-amino-4,6-dinitrophenol), 1,3,5-trinitro-1,3,5-triazacyclohexane (RDX), propylene glycol dinitrate (a component of Otto Fuel II), and trinitrotoluene (TNT), the U.S. Navy's Bureau of Medicine and Surgery (BUMED) has suggested target interim maximal contaminant levels in drinking water. In this report, the National Research Council's Committee on Toxicology evaluated the pertinent toxicity literature on the five contaminants and commented on the guidelines suggested by BUMED. In addition, where data on a particular compound were sparse, the Committee identified research that would provide a better basis for suggesting health criteria. (Author's abstract)
W88-00488

EFFECTS ON GROUNDWATER FROM SEEPAGE OF LIVESTOCK MANURE LAGOONS,
Clemson Univ., SC. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W88-00555

METHOD FOR TREATING THE UPPER LAYER OF A BODY OF WATER,
For primary bibliographic entry see Field 5G.
W88-00569

ENVIRONMENTAL ASSESSMENT: L-REACTOR OPERATION, SAVANNAH RIVER PLANT, AIKEN, S.C.
Department of Energy, Aiken, SC. Savannah River Operations Office.
For primary bibliographic entry see Field 6G.
W88-00644

ENVIRONMENTAL AND SOCIETAL CONSEQUENCES OF A POSSIBLE CO2-INDUCED CLIMATE CHANGE; VOLUME II, PART 8: IMPACTS OF RISING ATMOSPHERIC CARBON DIOXIDE LEVELS ON AGRICULTURAL GROWING SEASONS AND CROP WATER USE EFFICIENCIES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
J. E. Newman.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001004. Price codes: A04 in paper copy, A01 in microfiche. DOE/EV/10019-8, September 1982. 29 p, 9 fig, 2 tab, 27 ref. Contract No. DE-AS01-79EV10019.

Descriptors: *Plant growth, *Climatology, *Agriculture, Growth, Air pollution, Carbon dioxide, Water use efficiency, Environmental effects.

The effects of climate changes on agricultural growing seasons and crop adaptation responses is the subject of a research plan. The research activities are divided into two areas: (1) impacts on the physical environmental characteristics of the agricultural growing seasons and (2) the most probable food crop responses to the possible changes in atmospheric carbon dioxide levels in plant environments. In general, increased concentrations of carbon dioxide produce increased water use efficiencies. Water availability is the limiting factor in length of agricultural growing season in the tropical and subtropical regions whereas the frost-free period is the critical factor in the temperate and polar regions. Research priorities should focus on gathering more information in these fields, particularly concerning the mid-latitudes. (Cassar-PTT)
W88-00647

HEALTH EFFECTS OF LAND APPLICATION OF MUNICIPAL SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
N. E. Kowal.
EPA/600/1-85/015, September 1985. 78 p, 1 fig, 25 tab, 196 ref.

Descriptors: *Sludge, *Sludge disposal, *Land disposal, Soil disposal fields, Waste disposal, Wastewater disposal, Land management, Municipal wastewater, Wastewater.

The potential health effects arising from the land application of municipal sludge are examined, and these effects are appraised. The agents, or pollutants, of concern from a health effects viewpoint are divided into the categories of pathogen and toxic substances. The pathogens include bacteria, viruses, protozoa, and helminths; the toxic substances include organics, trace elements, and nitrates. For each agent of concern the types and levels commonly found in municipal wastewater and sludge are briefly reviewed. A discussion of the levels, behavior and survival of the agent in the medium, or route of potential human exposure, i.e., aerosols, surface soil and plants, subsurface soil and groundwater, and animals, follows as appropriate, infective dose, risk of infection, and epidemiology are then briefly reviewed. Finally, some general conclusions are presented. They include: public access to sludge spray sources should be limited; levels of allowable intake of dietary cadmium by

humans should not be raised; and groundwater nitrogen levels can be raised by land application, so care in siting disposal areas is necessary. (Halterman-PTT)
W88-00679

INTERACTIONS AMONG WATERFOWL, FISHES, INVERTEBRATES, AND MACROPHYTES IN FOUR MAIN LAKES OF DIFFERENT ACIDITY,
Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team.
For primary bibliographic entry see Field 2H.
W88-00680

TOXICITY OF LANDFILL LEACHATES.
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
Report EPS 4-EC-82-7, December 1982. Environmental Protection Service, Ottawa (Ontario). 36 p, 6 fig, 16 tab, 6 ref.

Descriptors: *Daphnia, *Trout, *Leachates, *Landfills, *Toxicity, *Water pollution effects, Tannin, Ammonia, Zinc, Copper, Hydrogen ion concentration, Pollutants, Fish, Rainfall, Wood wastes.

One hundred twenty-eight toxicity tests were performed on leachates from 26 simulated landfill lysimeters. Of these, 44 were performed as 96 hr-LC50 toxicity using rainbow trout, 42 as 96 hr LC50 toxicity using Daphnia pulex and 42 as residual oxygen bioassays (ROB) on rainbow trout. The relationships between contaminant concentrations and toxicity were: log Daphnia toxicity = 0.885 - 0.008 45Zn - 9.44 x 0.0001 tannin with a correlation coefficient of 0.733 and log fish toxicity = 1.427 - 0.386 un-ionized ammonia - 101 400(H(+)) - 5.39 x 0.0001 Tannin - 4.074 Cu with a correlation coefficient of 0.943. It is concluded that the Daphnia test could be used in place of the 96 hr LC50 fish toxicity test; that ROB is not a good predictor of Daphnia toxicity; and that the ROB test would be a useful replacement for the 96 hr LC50 fish toxicity test. Toxicity values are reduced significantly in all three test methods when pH is adjusted upwards from the natural pH to pH 7.0. This suggests that the procedure of raising pH to 7.0 for toxicity testing can be very misleading. The relationship between pH and toxicity is a function of leachate strength. Lower strength leachate toxicity is affected less by pH change than is higher strength leachate. The addition of organic materials to refuse tends to reduce leachate toxicity slightly. Leachate recycle is effective in reducing toxicity but only at rainfall rates > 380mm/yr. Leachate toxicity is reduced with time at high rainfall rates. Although toxicity is also reduced at lower rates, tanks receiving 380 mm/yr produce highly toxic leachates after 5 yr of operation. (Cutty-PTT)
W88-00684

ASSESSMENT OF ACID MINE DRAINAGE IN THE MISSOURI RIVER BASIN FOR MUTAGENIC AND CLASTOGENIC ACTIVITIES,
Missouri Water Resources Research Center, Columbia.
J. B. Hufham, L. Hemman, J. Dawson, S. Hamlett, and R. Terkonda.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207049/AS. Price codes: A02 in paper copy, A01 in microfiche, Final Technical Completion Report, September 30, 1982. 15 p, 1 tab, 27 ref. Contract No. 14-34-0001-027 and 2127. Project No. OWRT A-130-MO(1).

Descriptors: *Water pollution effects, *Mine drainage, *Mutagens, *Ames test, Acid mine drainage, Coal, Missouri River Basin, Slurries.

A slurry of bituminous coal in water and a sample of acid mine drainage water showed no mutagenic activity in the Ames test. Extraction of Wyoming and Missouri coal with acid, base, and distilled water produced fractions that also did not show any mutagenic activity, even at a 50-fold concentration of the extracts. The Ames test fell short of the requirements for a quick, easy, inexpensive method for routing screening of mine effluents for the following reasons: culture contamination, replicate variation, and toxicity of samples. (Cassar-PTT)
W88-00734

MASSACHUSETTS ACID RAIN MONITORING PROJECT: PHASE I,
Massachusetts Univ., Amherst. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W88-00745

1983 ANNUAL REPORT TO THE PRESIDENT AND CONGRESS: NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM.
Interagency Task Force on Acid Precipitation, Washington, DC.
For primary bibliographic entry see Field 5B.
W88-00786

1985 ANNUAL REPORT.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
June 1985. 40 p, 2 fig, 4 tab, 19 ref.

Descriptors: *Monitoring, *Water pollution effects, *Ecosystems, *Great Lakes, *Public health, Models, Comprehensive planning, Water management, Lake sediments, Research priorities, Fish, Trout, Environmental impact statement, Ecological effects, Economic aspects, Social aspects, Groundwater pollution, Air pollution, Toxins.

The Science Advisory Board to the International Joint Commission has five standing committees and six task forces. This report describes the activities of these groups and their conclusion. The Atmospheric Task Force investigates deposition to the Great Lakes. The Groundwater Task Force identifies the availability of adequate hydrogeologic maps for use in identifying areas of possible groundwater contamination. The Ecological Effects of Sediment Contaminants Task Force evaluates the significance of sediment contamination and develops remedial measures for in-place pollutants. The Ecological Considerations Committee advises the Board on impacts of human activity on the health and quality of the Great Lakes. The Health of Aquatic Communities Task Force examines data on the effects of toxic chemicals on aquatic communities. The Council of Great Lakes Research Managers assesses the adequacy of Great Lakes research and identifies research needs. The Human Health Effects Committee assesses the risk associated with chemicals identified in the Great Lakes ecosystem. The Modeling Task Force is preparing a report on models used in the management of the Great Lakes environment. The Social and Economic Considerations Committee reviews institutional arrangements by examining consensus management in Green Bay. The Aquatic Ecosystem Objectives Committee has proposed revised water quality objectives for lindane, ammonia and toxaphene, and developed ecosystem objectives by studying lake trout as an indicator of oligotrophy. The recommendations made by the Science Advisory Board include the development of a comprehensive monitoring and reporting system by each committee and task force. Limits for certain toxins are also recommended. (Geiger-PTT)
W88-00789

TROPHIC STATUS OF THE WINNEBAGO POOL LAKES, 1981,
Wisconsin Univ.-Oshkosh.
W. E. Sloey, and M. Brosseau.
March 1985. 73 p, 15 fig, 6 tab, 19 ref, append.

Descriptors: *Trophic level, *Wisconsin, *Water quality, *Lakes, *Chlorophyll, *Phosphorus, Turbidity, Eutrophication, Color, Secchi disks, Transparency, Cycling nutrients, Nutrients.

In 1981, chlorophyll a concentrations in Lake Winnebago and the other lakes of the Winnebago Pool were 50% lower than in summer 1976. Total phosphorus concentrations were also 30% lower and water transparency (Secchi disc) was 30% greater. General field observations showed much cleaner lakes with less obnoxious algal blooms. Neither the linear regression equation developed from the 1976-1977 study nor any other equation available from the literature correctly predicted the response of the lakes to reduced P in the eater columns. Based on the changes in the ration of chlorophyll to P, two different methods predict a more rapid response to reduction of P than had been expected. If these predictions are correct, a 50% reduction in total P in Lake Winnebago would result in only 20 micrograms chlorophyll/liter; rather than the 35 micrograms previously predicted. A survey of historical Secchi disc readings suggests that the improved water conditions in 1981 may have been due to the natural cyclic patterns in the system rather than abatement efforts. Underwater light, water color, turbidity, transparency and chlorophyll analyses showed that the compensation depth can be adequately predicted from Secchi disc; only about 26% of the light attenuation in Lake Winnebago can be attributed to chlorophyll (40% in the Upriver Lakes); Secchi disc can be corrected for color; and color-corrected turbidity and color-corrected Secchi disc can both accurately predict chlorophyll at levels below 50 micrograms chlorophyll/liter. (Geiger-PTT)
W88-00790

OIL POLLUTION RESEARCH, 1984,
Maine State Dept. of Marine Resources, Augusta.
For primary bibliographic entry see Field 5B.
W88-00799

REVIEW OF TRENDS IN LAKE ERIE WATER QUALITY WITH EMPHASIS ON THE 1978-1979 INTENSIVE SURVEY,
Ohio State Univ., Columbus. Center for Lake Erie Area Research.
For primary bibliographic entry see Field 5G.
W88-00801

EMPIRICAL METHODS FOR PREDICTING EUTROPHICATION IN IMPOUNDMENTS; REPORT 3: PHASE II, MODEL REFINEMENTS,
For primary bibliographic entry see Field 2H.
W88-00826

APPLICATION OF SISTER CHROMATID EXCHANGE IN MARINE POLYCHAETES TO BLACK ROCK HARBOR SEDIMENT: LABORATORY DOCUMENTATION PHASE,
Environmental Research Lab., Narragansett, RI.
G. G. Pesch, C. Mueller, C. E. Pesch, J. Heltshe, and P. S. Schauer.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-157372. Price codes: A04 in paper copy, A01 in microfiche. Technical Report D-85-1, January 1985. Final Report. 50 p, 3 tab, 42 ref, 2 append.

Descriptors: *Marine pollution, *Water pollution effects, *Genetic effects of water pollution, *Sister chromatid exchange, Black Rock Harbor, Connecticut, Polychaetes, Annelids, Bioassay, Marine sediments, Ocean dumping.

Pollutants in coastal marine environments may affect the genetic constitution of exposed organisms by either causing shifts in gene pool composition through selective mechanisms, or by acting directly on the genetic material to produce mutations. This report addresses the latter in an evaluation of the applicability of the cytogenetic technique of sister chromatid exchange (SCE) to measure genotoxic effects of highly contaminated dredged material, and the degree of variability and reproducibility inherent in the procedure. The SCE technique was applied to Nephyts incisa, an infaunal polychaete dominant in the benthic community of the Central Long Island Sound disposal site. The SCE response was measured in N. incisa exposed to suspended particulate and bedded phases of Black Rock Harbor (BRH) sediment in the laboratory. With the exception of one treatment in one experiment, the worm chromosomes

were uniformly nonresponsive to BRH sediment. Differences between experiments and between species within an experiment were found, but reasons for the differences are not known. Additional research is needed before SCE could be used for routine testing. (Halterman-PTT)
W88-00840

UTILITY OF THE SCOPE FOR GROWTH INDEX TO ASSESS THE PHYSIOLOGICAL IMPACT OF BLACK ROCK HARBOR SUSPENDED SEDIMENT ON THE BLUE MUSSEL, MYTILUS EDULIS: A LABORATORY EVALUATION,
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 5A.
W88-00841

LIMNOLOGICAL STUDIES AT EAU GALLE LAKE, WISCONSIN, REPORT 1: INTRODUCTION AND WATER QUALITY MONITORING STUDIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W88-00847

STUDY PROGRAM FOR DEVELOPMENT OF INFORMATION FOR USE OF OECD EUTROPHICATION MODELING IN WATER QUALITY MANAGEMENT: A QUALITY CONTROL IN RESERVOIRS COMMITTEE REPORT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W88-00869

WATER QUALITY CRITERIA FOR FRESHWATER FISH,
J. S. Alabaster, and R. Lloyd.
Butterworths, London. 1982. 361 p.

Descriptors: *Toxicity, *Water quality, *Fish, *Water pollution effects, Fisheries, Copper, Ecological effects, Suspended solids, Hydrogen ion concentration, Dissolved oxygen, Ammonia, Literature review, Phenols, Thermal pollution, Water temperature, Chlorine, Water quality standards.

This volume is a collection of twelve updated technical papers on water quality criteria for European freshwater fish, along with a report on toxicity testing procedures produced for the European Inland Fisheries Advisory Commission. The paper on finely divided solids discusses the direct effects of suspended solids on fish as well as their effects on reproduction, behavior, and food supply. The effects of extreme pH values, both acidic and alkaline, are reviewed. The effects of water temperature on embryos, fry and adults are considered along with the thermal effects on fisheries. The paper on monohydric phenols examines the direct lethal action and sublethal action on fish as well as data on invertebrates and algae. Another paper records the direct lethal and sublethal action of dissolved oxygen on fish and fish food organisms. The next five papers discuss the toxicity of Cl, Zn, Cu, Cd, and mixtures of toxicants to fish. Fish toxicity testing procedures discussed in the final paper include screening tests, tests to establish water quality criteria, effluent monitoring tests, legal tests, and river monitoring tests. (Geiger-PTT)
W88-00881

LABORATORY EVALUATION OF ADENYLATE ENERGY CHARGE AS A TEST FOR STRESS IN MYTILUS EDULIS AND NEPHTYS INCISA TREATED WITH DREDGED MATERIAL,
Environmental Research Lab., Narragansett, RI.
G. E. Zaroogian, C. Pesch, P. Schauer, and D. Black.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-157374. Price codes: A04 in paper copy, A01 in microfiche. Technical Report D-85-3, February 1985. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 56 p, 8 fig, 8 tab, 54 ref, append.

Descriptors: *Marine pollution, *Water pollution effects, Black Rock Harbor, Long Island, Polychaetes, Mussels, Marine sediments, Ocean dumping, Adenine, Adenylate energy charge, Bioassay, Dredging.

In order to assess the effects of dredged sediment contaminants resulting from ocean dumping, changes in adenine nucleotide metabolism were evaluated as indices of stress in the marine bivalve Mytilus edulis and the polychaete Nephtys incisa. The adenylate energy change (AEC) for M. edulis treated with 50% contaminated dredged material was significantly lower than other treatments in one test, but there were no differences for any treatment during a second test. The AEC for N. incisa treated with 50% contaminated sediment was significantly less than other treatments for both tests that were conducted. This methodology appears to be a highly sensitive method for measuring stress due to dredged material in these two organisms, because of the low variability associated with AEC measurements. Furthermore, both of the organisms tested here are excellent species with which AEC can be used to accurately assess their metabolic state and health condition when exposed to sublethal environmental perturbances. (Halterman-PTT)
W88-00890

BIOACCUMULATION OF CONTAMINANTS FROM BLACK ROCK HARBOR DREDGED MATERIAL BY MUSSELS AND POLYCHEATES,
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 5B.
W88-00891

CONSECUTIVE SYSTEM OF TESTS FOR ASSESSMENT OF THE EFFECTS OF CHEMICAL AGENTS IN THE AQUATIC ENVIRONMENT,
Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, The Hague (Netherlands).
D. M. M. Adema, I. R. Kuiper, A. O. Hanstveit, and J. H. Canton.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-167114. Price codes: A02 in paper copy, A01 in microfiche. Report P82/8, June 1, 1982. 14 p, 8 tab. Contract No. 227-77-1 Env.

Descriptors: *Water pollution effects, *Bioassays, *Ecosystems, *Toxicity, *Aquatic animals, Assays, Daphnia, Ecological effects, Fish eggs, Sensitivity analysis, Optimization, Fish toxins, Organic compounds, Fish, Plankton, Comparison studies, Cost analysis.

Seventeen laboratory tests were evaluated with eight chemicals to optimize combinations of single-species laboratory tests for the assessment of the aquatic toxicity of chemicals. In short-term testing (< or = 4 days), most of the algal species used were more sensitive than Daphnia or fish. In long term testing (> or = 2 wk), reproduction of Daphnia and egg-larval development of fish were among the most sensitive criteria. By choosing different combinations from the most useful tests, ten sets of tests were formed, including EEC and OECD base sets. The costs of the ten sets were compared with their weighted mean no observed effect concentration. The OECD base set (4 day algal-, 2 wk Daphnia-, and 4 day fish-test) proved to be a favorable combination in this comparison. Three chemicals (3,4-dichloroaniline, 4-chlorophenol, and tetrapropylenebenzenesulfonate) were tested in a well chosen set of laboratory tests (longest test: 2 wk) and in a semi-field test using an enclosed plankton community. The differences in no observed effect concentrations between the two test regimes were less than one order of magnitude for all three chemicals, but the type of results differed. The model ecosystem experiments proved useful in extrapolating results of laboratory tests to the ecosystem level, especially when studying the effect of chemicals on structure and function of ecosystems. (Geiger-PTT)
W88-00895

HABITAT SUITABILITY INDEX MODELS: JUVENILE ATLANTIC CROAKER,
Virginia Inst. Of Marine Science, Gloucester point. Dept. of Invertebrate Ecology.
R. J. Diaz.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-144428. Price codes: A03 in paper copy, A01 in microfiche. Report FWS/OBS-82/1-.21, July 1982. 22 p, 1 fig, 3 tab, 42 ref.

Descriptors: *Fish management, *Models, *Croaker, *Juvenile growth stage, *Aquatic habitats, Fish, Fish populations, Model studies, Habitats, Salinity, Temperature, Estuaries.

The habitat use information and habitat suitability index (HSI) model for the juvenile Atlantic croaker is intended for use in impact assessment and habitat management. The major dietary components of larval and juvenile croakers are copepods. Croakers spawn in the fall in marine waters. Juvenile croakers live in estuaries or marshes interspersed with tidal creeks under a wide range of temperature and salinities. The HSI model is a hypothesis of species-habitat relationships which has been applied to four hypothetical data sets - those of open water and marsh for both the Atlantic coast and the Gulf of Mexico coast. The HSI graphs are based on the assumption that the suitability of a particular variable can be represented by a two-dimensional linear response surface. Such variables as turbidity, salinity, rate of salinity change, temperature, dominant substrate and percent organic matter or volatile solids in sediment may be evaluated with the model. The proper interpretation of the HSI is one of comparison. The higher the HSI of an area, the greater is its potential to support croaker. (Geiger-PTT)
W88-00899

BIOLOGICAL EFFECTS AND INTERACTIONS OF PESTICIDES IN A SOIL-PLANT-WATER MICROCOSM,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5B.
W88-00909

POLLUTION FROM ALASKAN OIL AND GAS OPERATIONS: CITATIONS FROM THE OCEANIC ABSTRACTS DATA BASE (1974-NOV 82).
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W88-00911

ACID PRECIPITATION: EFFECTS ON THE AQUATIC ECOSYSTEM; CITATIONS FROM THE U.S. DEPARTMENT OF ENERGY (EDB) DATA BASE (1977-SEPT 83).
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 10C.
W88-00912

STUDY OF THE EFFECTS OF OIL ON CETACEANS,
Guelph Univ. (Ontario).
J. R. Geraci, and D. J. St. Aubin.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152991. Price codes: A13 in paper copy, A01 in microfiche. July 20, 1982. Final Report. 274 p, 47 fig, 59 tab, 193 ref, append.

Descriptors: *Oil pollution, *Water pollution effects, *Whales, *Mammals, *Oil spills, Marine animals, Toxicity, Animal behavior, Ecological effects, Cleanup operations, Fate of pollutants, Bioaccumulation, Animal metabolism.

The objectives of this study were: to determine the ability of cetaceans to detect and avoid an oil slick; to determine the effects of oil on the integument, and the ocular, respiratory, reproductive, digestive

and excretory systems of cetaceans; to evaluate the long-term impact of the above effects on cetacean survival and behavior, such as feeding, breeding, calving, and migration, also, analyze the potential for bioaccumulation of petroleum hydrocarbons and metabolites in cetaceans and where practical, determine the toxic threshold levels for mammalian species; and to identify a range of mitigating measures which would eliminate or minimize the effects of oil pollution on marine mammals. From the study it was found that Tursiops, as a representative odontocete, can detect oil, and is inclined to avoid it, especially after contacting it. Also, a dolphin or whale, anywhere except in the heart of a fresh spill, could not inhale enough vapor or ingest enough oil to pose any immediate threat. Due to limited studies conducted on a single species, the behavior of mysticetes toward the oil spill is not as certain, however, their reaction to contact oil is expected to be similar to that of odontocetes. (Author's abstract)
W88-00918

1983 ANNUAL REPORT – COMMITTEE ON THE ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
Report to International Joint Commission, November 1983. 30 p, 1 tab, 10 ref, append.

Descriptors: *Lake basins, *Public health, *Human diseases, *Epidemiology, *Research priorities, *Pollutants, *Ecological effects, *Policy making, Hazardous materials, Pathogens, Chemical wastes, Administrative aspects, Toxicity, Contamination.

A major activity of the Committee has been the evaluation of chemicals detected in the Great Lakes from the standpoint of health protection. Additional data are needed to determine the extent of human exposure and to establish a need for standard setting. Further data are also needed on the distribution and abundance of chemicals to establish priorities for further toxicology testing. Within these limitations, it is still possible to determine whether Acceptable Daily Intake (ADI) values are available for certain chemicals. Ecological studies can be done where the correlation between death or disease rates in geographic areas is established with some index of exposure to the putative risk factor in the same areas. Using such methods, the best-investigated water quality parameter has been fluoridation; the method, however, is subject to biases and misinterpretation. Studies based on individuals tend to be more sensitive, more conducive to adjusting for possible confounding factors and more expensive. It is recommended that consulting services in epidemiologic studies be procured to develop a strategy for epidemiologic studies on the human health effect of Great Lakes water contaminants. Population exposure to the chemicals of concern listed in previous reports should be determined, including pinpointing the source or sources of the chemical, the verification of information and data, and additional measurements as deemed appropriate. (Hawkins-Omniplan)
W88-00926

1983 REPORT ON GREAT LAKES WATER QUALITY.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
For primary bibliographic entry see Field 5B.
W88-00927

5D. Waste Treatment Processes

THEORETICAL ANALYSIS AND PRACTICAL APPLICATION OF THE KINETIC MODEL OF FLOCCULATION IN THE INTERPRETATION OF JAR TESTS,
Antwerpse Waterwerken (Belgium).
J. G. Janssens, and A. Buekens.
Aqua AQUAAA, No. 2, p 91-97, 1987. 4 fig, 4 tab, 28 ref.

Descriptors: *Kinetics, *Flocculation, *Model studies, *Data interpretation, *Wastewater treatment, *Water treatment, Alum, Polyelectrolytes, Coagulation, Drinking water, Literature review.

The orthokinetic flocculation performance, under non-uniform shear conditions can be modelled on the basis of the Argaman-Kaufman equation. This model was evaluated on the basis of a literature review and jar test results. During these jar tests alum, ferric chloride, and polyaluminum chloride (PAC) were compared as primary coagulants. The flocculation rate parameters were derived on the basis of the aforementioned model. These parameters vary with the nature of the coagulants used, with seasonal factors, and with the initial turbidity of the water to be treated. When treating low turbidity, algal laden water flocculation performance was best with PAC and poorest with alum. The flocculation rate equation only gives information on the reduction of primary particle during flocculation. In clarification system, the properties of flocs with respect to their eventual removal by sedimentation, flotation, or filtration is also important. The ultimate system design should always be approached within an integrated perspective, combining flocculation performance and specified floc properties as a function of the subsequent liquid solid separation process. (Airone-PTT)
W88-00063

ASSESSMENT OF CHLORINE DIOXIDE AS A MEANS OF LIMITING THE FORMATION OF ORGANOHALOGENATED COMPOUNDS (EVALUATION DU BIOXYDE DE CHLORE COMME MOYEN LIMITANT LA FORMATION DE DERIVES ORGANO-HALOGENES),
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
For primary bibliographic entry see Field 5F.
W88-00067

ELIMINATION OF SURFACTANTS BY PRECIPITATION/FLOCCULATION (ELIMINATION VON TENSIDEN DURCH FAELLUNG/FLOCKUNG),
M. Kolb, D. Grau, and B. Funke.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 20, No. 2, p 82-85, June 1987. 4 fig, 9 ref.

Descriptors: *Surfactants, *Wastewater treatment, *Flocculation, *Hydrogen ion concentration, Textile mill wastes, Calcium hydroxide, Soaps.

The elimination of anionic and nonionic surfactants by precipitation/flocculation with Fe(III)/Ca(OH)2 and Fe(II)Ca(OH)2 was investigated. The elimination of anionic surfactants follows the Freundlich equation. At a pH value of 8 and initial surfactant concentration of 10 mg/l the elimination amounts to only 10%, but at a pH value of 6 it is 40% (Fe(III)Ca(OH)2). With increasing surfactant concentration the elimination also increases. The elimination of nonionic surfactants can be described by the Langmuir equation. At an initial concentration of 1 mg/l the elimination amounts to only 20%, with decreasing pH value the elimination decreases slightly. Precipitation/flocculation experiments with Fe(II)Ca(OH)2 showed a significantly higher elimination in comparison with Fe(III)Ca(OH)2. The elimination of anionic surfactants follows again the Freundlich equation, the elimination of nonionic surfactants can be described by the Langmuir equation. Both surfactants were eliminated to a higher degree (up to 50%) when carrying out the experiments with original textile wastewater, probably due to enhanced hydrophobic character of the floc induced by the presence of soaps. (Author's abstract)
W88-00069

PROCESS CONSIDERATIONS IN BIOLOGICAL TREATMENT OF LOW CONCENTRATION WASTEWATERS: I. STEADY STATE,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
W. J. Maier, G. M. Klecka, and R. E. Bailey.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 20, No. 2, p 85-90, June 1987. 5 fig, 2 tab, 25 ref.

Descriptors: *Hydraulic design, *Activated sludge process, *Optimization, Industrial wastes, Wastewater treatment, Stage treatment, Reactors, Flow characteristics, Biological wastewater treatment, Mathematical models, Kinetics.

Process performance of well-mixed continuous flow reactors (CSTR) treating low concentration industrial wastewaters has been modeled to study the effects of reactor sizing and configuration. The study focuses on achieving high levels of treatment (90+% removal). It is shown that reactor staging is necessary and much more effective than increasing residence time of a single stage CSTR. The effects of endogenous decay of cell mass have been incorporated and show that there is an optimum residence time. The rate of endogenous decay becomes the controlling factor at long residence time and determines overall efficiency of substrate removal. (Author's abstract)
W88-00070

GROWTH OF BACTERIA IN AN OIL SHALE RETORT WATER BY INDIGENOUS MICROORGANISMS,
South Dakota State Univ., Brookings. Dept. of Microbiology.
W. K. Gauger, and S. E. Williams.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 5, p 769-774, May 1987. 2 fig, 1 tab, 9 ref. Dept of Energy Grant DE-AS20-79-LCO-1761.

Descriptors: *Sampling, *Sample storage, *Wastewater treatment, *Oil shale retort water, *Bacteria, *Indigenous microorganisms, *Bacterial growth, *Refrigeration, Microbial degradation, Wastewater storage, Organic carbon, Microbial studies.

Bacterial growth characteristics in refrigerated, oil shale retort water were assessed. Six bacterial growth experiments using an indigenous, mixed culture inoculum were performed using sterile Omega-9 retort water obtained from two different barrels. Total dissolved organic carbon levels (T-DOC) were measured at the beginning of each experiment. T-DOC measurements were performed to determine if psychrotrophic bacterial growth in the stored (refrigerated) retort water was reducing T-DOC levels via carbon assimilation. There was a chronological increase in the specific growth rate constants in each of the barrels, and levels of T-DOC decreased significantly over the storage period. Cold storage as an attempt to maintain stability and homogeneity of the Omega-9 research stock, was not an effective deterrent to microbial growth. The potential for using these organisms in the development of waste treatment control technology should be addressed. (Main-PTT)
W88-00081

MEASUREMENT AND CONTROL OF FEED WATER AND PRODUCT WATER COMPOSITION,
Dow Chemical Co., Freeport, TX. Electrochemicals Lab.
For primary bibliographic entry see Field 3A.
W88-00091

REVERSE OSMOSIS OF WASH WATERS FROM SIMULTANEOUS SO2/NOX WET REMOVAL TECHNIQUE OF FLUE GAS,
Gesamthochschule Essen (Germany, F.R.). Inst. fuer Technische Chemie.
W. Thamm, and E. Staude.
Desalination DSLNAH, Vol. 61, No. 1, p 27-37, February 1987. 7 fig, 2 tab, 13 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Reverse Osmosis, *Wash waters, *Flue gas, *Sulfides, *Nitrogen, *Power plants, Wet processing, Cellulose acetate membranes, Membrane filters, Flow ratios, EDTA.

A promising process for simultaneous SO2/NOx removal from flue gas consists in using Fe(II)-EDTA solutions as absorbing substrate for a coordinative bonding of NO. Its reduction to molecular nitrogen occurs by bisulfite which results form SO2 absorption. Economic and environmental requirements imply a need for a nearly complete recovery of the complexing agent, EDTA. For this purpose reverse osmosis can be used. With porous cellulose acetate membranes, a high enough rejection of EDTA can be achieved as well as the regulation of the concentration of the accompanying chlorides within the scrubber solution. The relevant selectivity of the membranes increases with rising working pressure. The required removal of the accompanying salts can be adjusted by different membrane annealing and by varying the concentration. (Author's abstract)
W88-00093

PRETREATMENT OF PECTIC WASTEWATER FROM ORANGE CANNING PROCESS BY AN ALKALOPHILIC BACILLUS SP.,
Government Industrial Research Inst., Shikoku, Takamatsu (Japan).
H. Tanabe, K. Yoshihara, K. Tamura, Y. Kobayashi, and I. Akamatsu.
Journal of Fermentation Technology JFTED8, Vol. 65, No. 2, p 243-246, April 1987. 2 fig, 1 tab, 17 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Biological wastewater treatment, *Pectins, *Food-processing wastes, Bacteria, Enzymes, Bacillus, Activated sludge process, Activated sludge.

An alkalophilic bacteria that secretes endo-pectate lyase was isolated from soil in Thailand and identified as a Bacillus sp. The strain, designated as GIR 621, was used as a pretreatment for more effective activated-sludge treatment of pectic wastewater from orange-canning factories. The bacterial pretreatment decreased the uronic acid of the wastewater by 91%, when supplemented with Polypepton, yeast extract, soybean powder, phosphorus and potassium (pH 10.0) for 36 hours. The strain did not grow on simple synthetic media or under nonalkaloid conditions, so the use of the potential phytopathogen should not involve biohazards. (Author's abstract)
W88-00151

WASTE STABILIZATION PONDS: PROBLEMS AND CONTROVERSIES,
Leeds Univ. (England).
D. Mara.
Water quality International, No. 1, p 20-22, 1987. 1 tab.

Descriptors: *Stabilization lagoons, *Wastewater treatment, *Stabilization ponds, *Pond designs, Temperature effects, Brazil, France, Mosquitoes.

For maximum efficiency, stabilization ponds, especially in warm climates, should be in series: an anaerobic pond, followed by a faculative pond and one or more maturation ponds. The various equations proposed for pond designs relating organic loadings and the annual mean temperature are considered and none were found to be adequate to describe the rate of change of permissible loading with temperature over a large range of temperatures. Controversy over the use of aquatic macrophytes, both floating and rooted in stablization ponds revolves around maintenance problems, mosquito bruding, and the poor removal rate for fical coliforms. In spite of such problems, ponds are an excellent, and in some cases the best, method of wastewater treatment. (Ray-PTT)
W88-00155

STUDY OF THE ACIDOGENIC PHASE OF THE ANAEROBIC FERMENTATION OF STILLAGE FROM ETHANOL DISTILLERIES,
Universidade Federal do Rio de Janeiro (Brazil). Escola de Quimica.
M. M. Machado, and G. L. Sant'anna.
Biotechnology Letters BILED3 Vol. 9, No. 7, p 517-522, July 1987. 2 fig, 5 tab, 13 ref.

Descriptors: *Anaerobic fermentation, *Ethanol distilleries, *Stillage, *Wastewater treatment, *Biological wastewater treatment, Digestion, Chemical oxygen demand, Methane bacteria, Food-processing wastes, Wastewater treatment.

Large volumes of stillage with high chemical oxygen demand (COD) are produced in such industries as cane sugar and molasses. Anaerobic fermentation, in high rate digesters, reduces the COD values by 80 to 90%. The concept that a two phase process (acidogenic and methanogenic) will reduce the residence time in these high rate digesters to improve the stability of the process and to increase the specific activity of bacteria in each phase was investigated using a bench scale continuously stirred reactor to study the acidogenic phase of the anaerobic fermentation of stillage. The residence time of the effluent in the reactor ranged from 15.7 - 8.2 hr, pH was around 5.0 and temperature was 35 C. The residence time had no appreciable effect on the production or composition of the organic acids. The main acid products in the reactor effluent were acetic, propionic and butric acids. The gas production was low for all experimental runs. In spite of the non favorable conditions, methanologic bacteria were produced in the acidogenic reactor. (Ray-PTT)
W88-00163

WATER REUSE.
Ann Arbor Science, Ann Arbor, MI. 1982. Edited by E. Joe Middlebrooks. 851 p.

Descriptors: *Water reuse, *Wastewater treatment, *Waste management, *Waste recovery, Wastewater, Land disposal, Wastewater irrigation, Wastewater farming, Wastewater management, Wastewater renovation.

The need for wastewater reuse has been recognized for many years, but until the past decade, little effort was devoted to implementing direct reuse systems. The purpose of this book is to provide an up-to-date account of many aspects of wastewater reuse. It opens with a chapter that summarizes state-of-the-art in wastewater reuse; chapters presenting details of each major area of activity follow. Readers interested in an overview only will find the introductory chapter an excellent primer on wastewater reuse. Engineering design, plant performance, detailed data on trace organics, and the results of viral and microbial analyses are presented, along with the legal and institutional constraints associated with wastewater reuse. The entire field of wastewater reuse is discussed, including potable reuse. Social and esthetic aspects of wastewater reuse are considered, and detail is devoted to health and safety considerations in wastewater reuse. An analysis of risks associated with potable reuse of wastewater is also presented. (See W88-00165 thru W88-00195) (Author's abstract)
W88-00164

INTRODUCTION AND OVERVIEW,
Clemson Univ., SC. Dept. of Agricultural Engineering.
E. J. Middlebrooks, and M. J. Humenick.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 1-28, 16 fig, 6 tab, 65 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Waste management, *Waste recovery, Wastewater, Wastewater irrigation, Wastewater management, Wastewater renovation.

The history of wastewater reclamation for human consumption is very limited, and information has been accumulated for only a few years. This paper provides an overview of various aspects of the reuse of wastewater. The applications for reclaimed wastewater include irrigation, industrial (including cooling water, wash water and boiler feed), recreational impoundments, groundwater recharge, groundwater protection (injection to prevent salt water intrusion), oil field repressurization, fire protection, refuse compaction and soil compaction. The wastewater reclamation processes discussed in the chapter include nitrogen removal, solids-contact treatment and phosphorous removal, granular media filtration, activated carbon adsorption, biological activated carbon, microscreening, membrane processes, ion exchange, distillation, foam separation, chemical oxidation and disinfection. Several of these processes have been combined to form systems that produce an end product suitable for uses ranging from irrigation to human consumption. (See also W88-00137) (Halterman-PTT)
W88-00165

WASTEWATER REUSE - AN ASSESSMENT OF THE POTENTIAL AND TECHNOLOGY,
Culp/Wesner/Culp, Cameron Park, CA.
R. B. Williams.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 87-136, 22 fig, 28 tab, 4 ref.

Descriptors: *Waste reuse, *Wastewater treatment, *Waste management, Wastewater, Wastewater irrigation, Wastewater management, Wastewater renovation, Legal aspects, Water flow.

Wastewater reuse has been practiced in one form or another for countless years in the United States, and probably in every other country in the world. This paper presents an overview and critical assessment of wastewater reuse, focusing not only on present wastewater treatment technology, but also on future potentials for reuse. Primary treatment, activated sludge, trickling filters, filtration following biological secondary treatment, coagulation-sedimentation (lime addition), and activated carbon adsorption processes are discussed. Some of the more recent advances in ion exchange, groundwater recharge by infiltration-percolation basins, nutrient removal, and reverse osmosis are also outlined. The potential exists for increased reuse of wastewater in fields of agricultural irrigation, landscape irrigation, steam electricity generation, and industrial cooling. Some of the sources of treated wastewater which will be available for reuse include secondary effluents from municipal wastewater treatment plants, industrial discharges treated by best available technology, discharges from steam electric plants and discharges from fish hatcheries. (See also W88-00164) (Halterman-PTT)
W88-00169

WASTEWATER REUSE IN ARID AREAS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 137-180, 5 fig, 13 tab, 64 ref.

Descriptors: *Water reuse, *Arid lands, *Wastewater treatment, Waste management, Wastewater, Wastewater irrigation, Wastewater management, Wastewater renovation, Aquifers.

Both reuse and recycling of wastewater are expected to increase dramatically in the future as new water resources become increasingly scarce and expensive to develop, and as groundwater is being depleted. This paper considers the deliberate or direct reuse of wastewater, which presently amounts to 940 million cu m/yr in the United States. Of this, 580 million cu m are for irrigation, 300 million cu m are for industrial use, 47 million cu m are for groundwater recharge, and 14 million cu m are for recreation, fish and wildlife. To this is added the incidental reuse of wastewater from streams and lakes that receive sewage or other wastewaters. Direct reuse of wastewater is practiced most in arid areas and other regions where population growth and industrial activity are limited by available water resources. Public health and agronomic aspects of irrigation with reused water are detailed. Futhermore, various aspects of groundwater reuse, unique to arid areas, are discussed. (See also W88-00164) (Halterman-PTT)
W88-00170

HUMAN FACTORS ENGINEERING AND WASTEWATER REUSE,
Weston (Roy F.), Inc., West Chester, PA.
W. P. Lambert, and P. Y. Yang.
IN: Water Reuse, Ann Arbor Science, Ann Arbor,

MI, 1982. p 181-198, 6 fig, 21 ref.

Descriptors: *Systems engineering, *Water reuse, Wastewater, Wastewater management, Wastewater renovation, Wastewater treatment, Waste recovery, Engineering.

Men plus machines and their environment comprise the man/machine system. The goal of human factors engineering (HFE) is minimization of system failures caused by inappropriate man/machine interactions. This paper provides a simplified introduction to the discipline of HFE, and describes a case study in which the end-item design and performance of a project would suffer in explicit hardware and software accommodations were not made for the persons expected to operate the system. Engineers confronted with the problem of designing complex reuse systems to be operated by minimally trained people can benefit from HFE. Three major areas of HFE are discussed. First, ' anthropometric machine design', the study of human body measurements, is presented. This area simply ensures that the operator can reach and turn all dials, knobs and levers. Second, 'outside-in system design' permits the operator to come first as the priority subsystem, thus allowing for variation in operator capability to acquire, synthesize and evaluate information. Third, 'operator job design' is the link between man/machine interfacing with the operating system and man/organization interfacing with the management structure. (See also W88-00164) (Halterman-PTT)
W88-00171

POTABLE WATER REUSE,
Black and Veatch, Denver, CO.
K. D. Linstedt, and M. R. Rothberg.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 199-212, 5 fig, 1 tab, 26 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Waste management, Legal aspects, Wastewater management, Wastewater renovation, Regulations, Water law.

The earliest potable reuse practices were generally fostered by an acute water resource problem related to severe drought conditions which limited the available options for water supply sources. However, more recent potable reuse projects have not necessarily been responsive to emergencies, and have included rather thorough and extensive planning. In these cases a course involving potable reuse has been pursued only after considering many alternatives for dealing with a long-term water supply situation. This paper discusses motivations for potable water reuse, factors which limit the implementation of potable eater reuse, and presents some ideas on planning for future potable reuse. Since no water quality standards exist for potable water reuse, more stringent standards must be developed. Two plans are presented which will help address the suitability of renovated water for potable reuse: one, conduct in-depth toxicological and epidemiological studies to identify problems and help develop standards; and two, provide renovation treatment capabilities that would remove all contaminants. (Halterman-PTT)
W88-00172

DUAL WATER SYSTEMS IN WATER REUSE,
Weston (Roy F.), Inc., West Chester, PA.
A. K. Deb.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 213-234, 9 fig, 11 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Waste management, Wastewater, Wastewater renovation, Legal aspects, Regulations.

If it is assumed that recycled water will not be employed for potable uses, a separate distribution system will be necessary for supplying water for non-potable uses. In fact, dual supply systems, (in which two qualities of water, potable and non-potable, would be supplied to consumers through separate distribution systems) would be a necessary feature of water management in areas where wastewater reuse will be considered. Dual water supply can also be adopted in cases where raw water source quality is poor and has high organic, heavy metal, and total dissolved solids content. The cost of removing these materials is high, and dual supply systems may be economically viable over the conventional systems. A dual water supply should be an essential consideration in a long-term water management plan for a city or region considering conservation and optimum uses of water. This paper presents data on capital costs of programs, as well as discussions of pertinent regulations and guidelines, and various models of dual supply systems. (See also W88-00164) (Halterman-PTT)
W88-00173

REVERSE OSMOSIS IN WATER REUSE SYSTEMS,
Utah State Univ., Logan. Div. of Environmental Engineering.
D. B. George.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 235-264, 14 fig, 3 tab, 25 ref.

Descriptors: *Water reuse, *Wastewater, *Wastewater treatment, *Reverse osmosis, Waste recovery, Wastewater management, Wastewater renovation.

Membrane processes have been employed successfully by industry and municipalities to remove dissolved inorganic and organic compounds. Membrane processes used in water and wastewater systems are reverse osmosis, ultrafiltration, and electrodialysis. When a solution of a solute is separated from pure solvent by a semipermeable membrane which allows the flow of solvent, but not solute, osmosis occurs. The concentration of solvent molecules in the solute solution is less than in the pure solvent. The system will compensate for this difference by net transport of solvent across the membrane into the solute solution until the concentration of the solvent is equal on both sides of the membrane. An increase in the pressure above the osmotic pressure on the concentrated solute side of the membrane will reverse the flow of the solvent through the membrane from the concentrated solute to the dilute solution. Cellulose-acetate and polyamide membranes are generally deployed in a variety of possible modules, including 'plate-and-frame', 'spiral wound', 'tubular, and 'hollow fiber'. Several case-studies are presented as examples of reverse osmosis successfully utilized in water reuse systems. (See also W88-00137) (Halterman-PTT)
W88-00174

IMPLEMENTING DIRECT WATER REUSE,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
J.-C. Huang.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 265-276, 1 fig, 4 tab, 10 ref.

Descriptors: *Water reuse, *Wastewater management, *Wastewater treatment, *Wastewater, Wastewater renovation, Waste management, Waste recovery.

The subject of direct water reuse has traditionally been very controversial. As long as there is enough natural water in a local area to meet its demand, there is no need to practice such reuse. However, in some arid or semi-arid areas, or in some island countries in the world, direct water reuse is often more economical than desalination of salt water. Under such circumstances, serious consideration must be given to direct water reuse. The author of this paper contends that the public today is not psychologically ready to accept such a reuse. Currently available treatment technology appears to produce effluents of sufficiently high quality that they are more or less harmless to drink despite some uncertainties that no one really can know for sure. At present, the public psychological barrier outweights the technical credibility toward the reuse application; thus, a professional 'public relations' campaign is needed. The use of a receiving stream to serve as a natural barrier to give a first warning sign of any potential toxicity in the public water supply would be a means of safeguarding public health. (See also W88-00164) (Halterman-PTT)
W88-00175

WATER RECLAMATION EFFORTS IN THE UNITED STATES,
California State Water Resources Control Board, Sacramento.
T. Asano, and R. S. Madancy.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 277-291, 3 fig, 10 tab, 7 ref.

Descriptors: *Water reuse, *Wastewater management, *Wastewater treatment, Wastewater renovation, Wastewater, United States, Legal aspects, Public health.

Renovation of wastewater for beneficial use has been practiced in many parts of the world for many years. In highly industrialized nations, there are growing problems of providing adequate water supply and municipal and industrial wastewater disposal. In the United States, between now and the year 2000, freshwater withdrawals are expected to drop from 356.3 to 330.9 billion gallons per day (bdg); wastewater recycling by industry is expected to rise from 386.7 to 865.5 bgd; and municipal wastewater reuse is expected to rise from 2.1 to 4.8 bgd. The major categories for which recycled wastewater is used include steam electric generation, manufacturing industries, mineral industries, and municipal needs. Special attention is directed to the planning methodology, categories of wastewater reclamation and reuse, and constraints to wastewater reclamation and reuse. (See also W88-00164) (Halterman-PTT)
W88-00176

RISK ASSESSMENT IN WATER REUSE,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
N. J. Hutzler, and W. C. Boyle.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 293-324, 3 fig, 14 tab, 86 ref, append.

Descriptors: *Water reuse, *Wastewater treatment, Waste management, Wastewater, Hazards, Safety, Risk assessment, Diseases, Human diseases.

The United States enjoys one of the safest water supplies in the world. Any suggestion to compromise this safety by increased recycling of wastewater must be viewed with suspicion. However, as unpolluted water resources become scarcer, the risks of disease transmission must be weighed against the risk of having no water. The conclusions drawn from the studies presented in this paper included: any effort to control infectious disease will probably reduce the risk. However, not all control measures have the same effect. Those occuring nearest the source will have the greatest effect. Obviously, eliminating the source will eliminate risk completely. While it may not be possible to reduce risks to zero, the engineer should calculate risks as objectively and completely as possible with the goal of minimizing the overall risks as much as possible. Finally, a good design should include safeguards, especially disinfection capable of inactivating viruses and protozoan cysts. (Halterman-PTT)
W88-00177

DISINFECTION FOR REUSE,
Utah State Univ., Logan. Coll. of Engineering.
V. D. Adams.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 325-346, 3 fig, 1 tab, 47 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Disinfection, *Chlorination, Waste management, Wastewater, Hazards, Safety, Risk assessment, Diseases, Human diseases.

As discharge regulations become more stringent and our water resources become more limited, water reuse using high level sophisticated wastewater treatment technology to augment our domestic water supplies is becoming increasingly important. The most important aspect of the treatment process to control will definitely be the disinfection process. Although chlorination is a very effective and acceptable means of disinfection, beneficial uses of the waters for reuse may be limited unless costly techniques for further purification are

used. If ozonation is to be used, extensive research on the area of reaction products and health effects must be conducted. Although ultraviolet radiation has excellent disinfection qualities on good quality water, the reliability of ultraviolet treatment as a wastewater disinfection process does not look promising for treatment of wastewater for reuse. The main disadvantages of chlorine dioxide are its high cost and unknown health hazards. Clearly, extensive research is required to fully develop the technology required to reuse wastewater for human consumption. (See also W88-00164) (Halterman-PTT)
W88-00178

ASSESSMENT OF AQUACULTURE FOR RECLAMATION OF WASTEWATER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
W. R. Duffer.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 349-367, 7 tab, 42 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Aquaculture, Waste management, Wastewater renovation, Wastewater management, Wastewater, Wetlands, Aquatic plants, Rooted aquatic plants, Water hyacinth.

Wastewater aquaculture is a relatively new field in the United States, but it has a large potential for application to environmental problems. This paper focuses on aquatic plants, natural and artificial wetlands, aquatic invertebrates, finfish, and highly structured or integrated systems. Technology development in connection with natural processes to treat municipal wastewater has been substantial during recent years. This development is consistent with new national attitudes which are oriented beyond resource utilization and environmental protection to the broader concepts of resource recycling and environmental enhancement. Wastewater treatment processes using water hyacinth, natural and artifical wetlands, and finfish are in various stages of development. Due to treatment effectiveness and the potential for cost and energy savings, aquacultural processes are being considered by at least 30 municipalities in the United States. In view of the encouraging results of previous research in this area, research efforts should be expanded in the future. (See also W88-00164) (Halterman-PTT)
W88-00179

MICHIGAN WETLAND WASTEWATER TERTIARY TREATMENT SYSTEMS,
Williams and Works, Grand Rapids, MI.
J. C. Sutherland.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 369-378, 5 fig, 11 ref.

Descriptors: *Water reuse, *Wastewater, *Wastewater treatment, *Wetlands, Wastewater irrigation, Wastewater management, Land disposal, Michigan, Tertiary wastewater treatment.

Between Michigan's larger cities and her uninhabited forest and waterlands lie several hundred well-established communities with populations ranging from fewer than 100 to more than 1000. With such communities, potable water is provided either by household wells or community wells through a public distribution system. Methods of managing sanitary wastewater from these towns have been evolving since the early 1960s. Because of the high cost of conventional treatment, Michigan's small communities have been increasingly served by stabilization ponds and upland irrigation systems in response to phosphorous and nitrogen removal requirements. This paper details many aspects of the Vermontville pond and irrigation system and the Houghton Lake area treatment facility, both of which utilize wetlands for tertiary treatment systems. The expansion of this program in other areas is strongly recommended by the author. (See also W88-00164) (Halterman-PTT)
W88-00180

FRESHWATER FISH CULTURE WATER REUSE SYSTEMS,
Lubbock Christian Coll., TX. Inst. of Water Research.
D. B. George.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 379-417, 17 fig, 6 tab, 72 ref.

Descriptors: *Water reuse, *Wastewater, *Aquaculture, Wastewater treatment, Ammonia, Nitrite, Toxicity, Model studies, Nitrification.

The optimization of fish production has been the goal of fish culturists since the inception of the science of aquaculture. Good water, food and appropriate water temperature are prime requisites for achieving this goal. The cost of providing good water, however, is becoming the primary problem of fish culturists. Water pretreatment capital and operating costs can be reduced substantially by reducing the volume of water to be treated. This reduction can be accomplished through water reuse systems. The waste product of most concern to fish culturists is ammonia because of its toxic effect at very low concentrations. For reuse facilities, biological nitrification is considered to be the most practical and economical method of ammonia removal. This paper reviews the nitrification process and the ammonia and nitrite toxicity to fish, then continues to describe in detail design criteria for successfully reusing wastewater for freshwater fish culture. (See also W88-00164) (Halterman-PTT)
W88-00181

PISCICULTURE IN WASTEWATER,
Arkansas Game and Fish Commission, Lonoke.
S. Henderson.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 419-428, 20 ref.

Descriptors: *Water reuse, *Wastewater treatment, Waste recovery, Wastewater, Aquaculture, Fish farming, Fish ponds, Salmon, Channel catfish, Chinese carp.

Pisciculture in wastewater still remains largely conceptual from practical standpoint. The fish culture method that appears to be the most promising for wastewater reuse is pond culture. This paper discusses current and recent research on the culture of salmon, channel catfish, baitfish and Chinese carp. In present-day freshwater pond aquaculture, the greatest overhead costs are land, feed, fertilizer and water. By utilizing a system of wastewater aquaculture, these costs would be born by the primary function of water treatment. Based on this assumption, one study realized a net profit of 2.3 cents/1000 gal wastewater passing through the plant from the sale of food fish and baitfish. Several other possibilities for fish culture in wastewater were also discussed. Among these were the use of cannery wastes because there is no need to remove toxins, and heated effluents because the hot water could be mixed with other water as a means of temperature control. (See also W88-00164) (Halterman-PTT)
W88-00182

WASTEWATER RECLAMATION AND REUSE AT MILITARY INSTALLATIONS,
SCS Engineers, Inc., Long Beach, CA.
C. J. Schmidt, M. Gilbert, E. V. Clements, and S. P. Shelton.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 465-483, 5 fig,4 tab, 3 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Wastewater management, Waste management, Wastewater, Waste recovery, Wastewater renovation.

Military bases are often excellent candidates for on-site wastewater reclamation and reuse for many reasons. A large percentage of the freshwater supply is used for nonpotable purposes; there is often relatively close proximity of wastewater sources to potential water uses; there are usually well-controlled areas where public access can be limited and health risks minimized; military bases often have the capability to implement reuse systems quickly. Some of the activities that have an excellent potential for reuse are sewage and industrial wastewater treatment plants, irrigated golf courses and landscapes, large cooling towers, plating shops, wash racks, and steam cleaning facilities and other large industrial water users. Some positive factors for reuse are water supply shortages or high costs, permit requirements for discharging wastewater, arid climate and absence of legal/institutional constraints to reuse. Some negative factors for reuse include an ample water supply, absence of irrigation potential, and lack of enthusiasm for reuse among key personnel. Several reuse schemes are presented. (See also W88-00164) (Halterman-PTT)
W88-00183

MUNICIPAL WASTEWATER REUSE IN POWER PLANT COOLING SYSTEMS,
Water Purification Associates, Cambridge, MA.
D. J. Goldstein, and J. G. Casana.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 431-464, 6 fig, 10 tab, 53 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Wastewater management, Wastewater, Power plants, Cooling water, Water cooling, Waste management.

Maintaining an adequate water supply is becoming an increasingly difficult problem in many areas of the United States. The high cooling water requirement for electric power generation suggests the use of alternative water sources for cooling purposes. Several electric power plants in the southwestern United States are currently using sewage water for cooling. This paper discusses some of the aspects of this application and evaluates design procedures, using the electric power industry for illustrative purposes. Conclusions gained from current practice include: calcium phosphate scale can be controlled by acid addition, ammonia is not a problem, and slime can be controlled by chlorination. (See also W88-00164) (Halterman-PTT)
W88-00184

SEAWATER INTRUSION CONTROL WITH WASTEWATER,
Ventura Regional County Sanitation District, CA.
For primary bibliographic entry see Field 4B.
W88-00185

PROBLEMS OF WATER REUSE IN COKE PRODUCTION,
Carnegie-Mellon Univ., Pittsburgh, PA.
R. G. Luthy.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 501-520, 2 fig, 5 tab, 44 ref.

Descriptors: *Water reuse, *Steel industry, *Wastewater, Wastewater management, Wastewater renovation, Wastewater treatment, Waste management, Industrial plants.

The high salt content of coke plant wastewater restricts its reuse in other process units in an integrated steel plant, unless demineralization is conducted. Technologies to achieve demineralization of coke plant effluents are not proven, although reverse osmosis offers the best possibility of the basis of experience in related industries. Demineralization of coke plant wastewater will be expensive, and it may be argued that those expenditures are not justified for eastern iron and steel facilities where there are no severe water shortages. One form of reuse, which would also dispose of coke plant wastewater, is the quenching of hot incandescent coke. However, the impact of this process on land, water and air, collectively, must be considered. Such considerations made so far indicate that the selection of appropriate technologies must not emphasize a single medium (air, land, or water) regulation and solution. Previous analyses and experience in Germany suggest that the best environmental management strategy may entail a moderate degree of wastewater treatment with wastewater disposal by quenching. (Halterman-PTT)
W88-00186

INDUSTRIAL REUSE OF WASTEWATER: QUANTITY, QUALITY AND COST,
Montgomery (James M.), Inc., Pasadena, CA.
G. P. Treweek.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 521-548, 3 fig, 8 tab, 8 ref.

Descriptors: *Water reuse, *Industrial plants, *Wastewater, *Wastewater management, Wastewater renovation, Wastewater treatment, Waste management, Waste recovery.

Industrial reuse of wastewater offers several distinct advantages, compared to other uses such as agricultural irrigation or groundwater injection. For instance, the point of application is often located near the source of supply; the water quality requirements of major industrial applications can often be met by a well-treated secondary effluent with some internal chemical addition to minimize scaling, corrosion, fouling and biological growth. Raw wastewater is unsuitable for most industrial uses, primarily because of organic contamination; however, primary and secondary treatment reduce organics to a suitable level. The reuse of reclaimed wastewater does not, however, represent a new low-cost alternative to freshwater withdrawal or recycling. If additional freshwater resources are available for development or in-house recycling can be practiced, then either of these alternatives will be lower in cost than reuse of wastewater. Therefore, reclamation and reuse can only be justified if freshwater is scarce, if reuse is the most cost effective means of effluent disposal, or if public policy mandates reuse to conserve high-quality freshwater supplies. (Halterman-PTT)
W88-00187

INTERNATIONAL DEVELOPMENTS AND TRENDS IN WATER REUSE,
Utah Water Research Lab., Logan.
J. Messer.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 549-576, 8 fig, 7 tab, 38 ref.

Descriptors: *Water reuse, *Wastewater management, *Wastewater treatment, *Wastewater, Waste management, Wastewater irrigation, Israel, United Kingdom, Japan, Australia, India, Canada, Saudi Arabia, Virgin Islands, Indonesia, Hong Kong.

Because of the diverse needs for water reuse technologies among different countries, the solutions become characteristic, or even unique. In water-rich, but heavily industrialized areas such as the low Rhine and Thames River Basins, problems are predominantly associated with heavy reuse cycles. Indirect reuse factors have already reached 22% and 13% in these basins, respectively. In arid regions, oceanic islands and arctic settlements, development of freshwater sources difficult and expensive. Reuse in these areas is often more economical than the desalination of marine waters. In many semi-arid and agricultural communities, the application of wastewater to irrigated agriculture represents a means of simultaneously disposing of a pollutant while increasing productivity. The relative trade-offs between increased nutritional status and increased disease transmission appears to be largely unknown. While water reuse cannot replace conservation and development of new surface and groundwater resources, the author of the paper believes it can help improve the quality of life and the global environment. (See also W88-00164) (Halterman-PTT)
W88-00188

WASTEWATER REUSE IN THE FOOD PROCESSING INDUSTRY,
Esvelt Environmental Engineering, Spokane, WA.
L. A. Esvelt.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 577-599, 4 fig, 18 ref.

Descriptors: *Water reuse, *Food processing industry, *Food processing wastes, Wastewater management, Wastewater, Wastewater renovation, Legal aspects, Regulations.

Regulations in the United States call for a water supply of 'adequate' quality and quantity in all food processing plants. Consequently, reuse of reclaimed wastewater in the food industry has not been implemented to a great extent in the United States to date. The two wastewater reclamation and reuse projects in demonstration phases in this country are being monitored closely by the EPA Health Effects Research Laboratory, the FDA, and the USDA. These projects are extensively monitoring reclaimed water quality on a long-term basis for priority pollutants such as heavy metals, pesticides, halogenated organics and microbiological quality. One of the plants processes high-acid fruits and the other processes poultry. The treatment technology for reclaiming food processing plant effluents for reuse will probably consist of conventional processes. If this is acceptable, the likelihood of implementation industry-wide is much higher than if more advanced technology, like reverse osmosis, is required. Recognition that only a small quantity of reuse water will actually be consumed should be a consideration when determining the acceptance of reclamation and reuse of wastewater in the food industry. Presently, the regulatory agencies and the food processing industry are jointly considering the criteria under which reclaimed effluents may be used in food processing plants. (Halterman-PTT)
W88-00189

VIRUS UPTAKE BY MINERALS AND SOILS,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5B.
W88-00190

VIRUS REMOVAL WITH LAND FILTRATION,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
J. C. Lance, and C. P. Gerba.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 641-660, 5 tab, 58 ref.

Descriptors: *Water reuse, *Wastewater management, *Viruses, Wastewater renovation, Wastewater treatment, Waste management, Wastewater, Wastewater disposal.

Since more than 100 types of viruses are found in sewage water, virus removal is an important consideration in determining the best use for wastewater and the amount of treatment needed before various kinds of wastewater reuse can be implemented. Laboratory studies have shown that increased ionic composition of suspending solution greatly increases virus adsorption and that viruses can be desorbed by distilled water. Batch studies have shown how some factors, such as ionic strength of the solution and interference by organic compounds, affect virus adsorption. However, quantitative predictions have not been possible using batch studies. Soil column work has been more useful for quantitative data gathering. Indications are that 1.0 m of travel through soil with an infiltration rate of less than 1 m/day is needed for a 2-log reduction in virus concentration and about 2.5 m travel is needed for a 4- or 5-log reduction. In general, if land treatment systems are carefully designed and managed, they will produce high quality renovated water that can be reused for a variety of purposes. (See also W88-00164) (Halterman-PTT)
W88-00191

AUTOMATED WATER-QUALITY MONITORING,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
For primary bibliographic entry see Field 5A.
W88-00192

CONCENTRATION OF VIRUSES FROM AQUEOUS ENVIRONMENTS: A REVIEW OF THE METHODOLOGY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
G. Belfort, and D. M. Dziewulski.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 679-750, 5 fig, 11 tab, 168 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Virus, Wastewater, Wastewater management, Wastewater analysis, Wastewater renovation, Waste management, Municipal wastewater.

This paper reviews information pertaining to the concentration of viruses from aqueous environments. The ideal technique must be relatively simple, rapid, inexpensive, efficient, able to handle large volumes of water without regard to the quality of the water, and it must be consistently able to detect a wide variety of viruses at low concentrations. Variations of filter adsorption-elution techniques have been able to fulfill several of these requirements. The major drawbacks are clogging and inability to concentrate all types of viruses. Although process times for another methodology, ultrafiltration, are longer than for adsorption-elution, advances in tangential flow hollow fiber ultrafiltration have made it possible to produce permeate at rates of 1-2 l/minute. All methods suffer, however, when samples contain high organic loads. The author emphasizes the importance of continuing research on methods that will improve the ability to concentrate viruses from naturally turbid water and recover a wide diversity of viruses. (See also W88-00164) (Halterman-PTT)
W88-00193

HEALTH EFFECTS AND LAND APPLICATION OF WASTEWATER,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Reed.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 753-781, 3 fig, 16 tab, 55 ref.

Descriptors: *Land disposal, *Water reuse, *Wastewater management, *Public health, Wastewater, Wastewater renovation, Waste management, Waste treatment, Wastewater disposal.

Protection of public health is the fundamental purpose of waste treatment. This paper describes the current land treatment technology and considers whether or not potential health risks exist and, if so, what mitigating approaches are possible. The authors conclusions include: (1) Proper design and operation of land treatment systems will eliminate, or control, adverse health impact from nitrogen and phosphorous, (2) Accumulated phosphorous and metals in the soils pose no hazards, even after shutdown of the site, (3) The potential impacts of pathogens are transient in nature and should not increase with long-term operation of the site, (4) Land treatment of wastewater is a viable treatment alternative. It is recommended that treatment sites should not be placed on perched (closed) groundwater systems with high rates of withdrawal and slow recharge; soil pH should be maintained near neutral; no food crops which are to be eaten raw should be grown near the site; no dairy animals should be permitted in the area; and chlorine disinfection of wastewater prior to land application should be avoided. (See also W88-00164) (Halterman-PTT)
W88-00194

PERSISTENCE OF CHEMICAL POLLUTANTS IN WATER REUSE,
Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
A. J. Englande, and R. S. Reimers.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 783-819, 12 tab, 29 ref.

Descriptors: *Wastewater, *Wastewater treatment, *Wastewater management, *Water reuse, Chemical analysis, Chemical wastes, Industrial wastes, Wastewater analysis, Wastewater renovation.

Because the desired quality of water for reuse varies with anticipated usage, reuse applications require emphasis on the removal of selected physical, chemical and biological constituents to use-specific, nonadverse levels. This paper focuses on chemical pollutants, particularly trace metals and trace organics, which tend to persist through biological and physical-chemical treatment systems for both municipal and industrial waste waters.

Chemical parameters found to consistently exceed water quality criteria for intended use include: total dissolved solids, ammonia and nitrate, phenol, trace organics, and specific heavy metals. Various treatment processes are discussed, and specific efficiencies that they demonstrate, are described. For instance, selected pesticides, phenol, and halomethane were removed fairly readily by activated carbon adsorption. Reverse osmosis and ammonia stripping removed organics with atomic mass greater than 200. However, biological secondary treatment, chemical precipitation and flotation were generally ineffective in terms of removal of selected pesticides, phenol and halomethane. Since effluent residual levels for organics are not well defined, a study should be initiated to monitor various industrial, combined and municipal plants in order to ascertain residual levels for trace organic constituents. (See also W88-00164) (Halterman-PTT)
W88-00195

FOURTH CONFERENCE ON ADVANCED POLLUTION CONTROL FOR THE METAL FINISHING INDUSTRY.
January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab. -Cincinnati, Ohio, December 1982. 94 p. Contract No. 68-03-2672.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Physicochemical treatment, Water pollution, Regulations, Legal aspects, Electrodialysis, Electrolysis, Electrochemistry.

The proceedings of a conference pertaining to pollution control in the metal plating industry are presented. Specific topics covered include regulatory issues, sludge leachability, hazardous waste management technologies, oil wastewater treatment, aluminum finishing waste treatment, ion-exchange, acid recovery, electrodialysis, and batch hydrolysis destruction of cyanides. The symposium was sponsored by the American Electroplaters' Society and the United States Environmental Protection Agency's Nonferrous Metals and Minerals Branch. (See W88-00209 thru W88-00221) (Halterman-PTT)
W88-00208

STATUS OF EFFLUENT GUIDELINES FOR THE METAL FINISHING INDUSTRY AND THE GENERAL PRETREATMENT REGULATIONS,
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
J. D. Denit.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 6-7.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Physicochemical treatment, Water pollution, Regulations, Legal aspects, Electrodialysis, Electrolysis, Electrochemistry.

The regulations impacting the metal finishing industry have not been finalized by the EPA; however, a series of recommended guidelines are presently under review. It is expected that slight changes will be made during the review process. In developing the upcoming metal finishing regulations, the EPA has responded to problem areas, and made modifications which will make these regulations clearer and more reasonable. The major changes include the use of concentration basis versus production; greater coverage of total plant process wastewater under one regulation; consideration of removal which occurs at the municipal wastewater treatment facility; and separation of studies of job shops and printed circuit board manufacturers to account for economic impact. Each of these major changes is discussed in detail, followed by a presentation of the staff recommendations for the regulation. Removal rates, and daily maximum and 30-day maximum effluent concentrations for appropriate metals are listed. (See also W88-00208) (Halterman-PTT)
W88-00209

DETERMINATION OF THE RELATIONSHIP BETWEEN PLANT OPERATING CONDITIONS AND WASTEWATER SLUDGE LEACHABILITY,
Centec Corp., Reston, VA.
A. Procko.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 14-20, 1 fig, 4 tab.

Descriptors: *Metal-finishing wastes, *Sludge, *Industrial waste, Metals, Wastewater treatment, Physicochemical treatment, Regulations, Cadmium, Nickel, Chromium, Copper, Zinc.

An investigation of the primary operating variables of treatment systems on the effluent quality and the leachability of heavy metals from sludges, is presented. Operations and sludges from six plants carrying on a wide variety of planting operations are characterized. Results indicate d that the effluent quality varied, however. Nickel, cadmium, zinc, chromium and copper were effectively removed by different combinations of CaO, NaOH, and Na2CO3. The sludges from all the plants tested were determined to be initially hazardous. The sludge from only three of these plants could be made non-hazardous. (See also W88-00208) (Halterman-PTT)
W88-00210

SEGREGATED NEUTRALIZATION FOR TREATMENT OF CONCENTRATED ALUMINUM FINISHING WASTES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
F. M. Saunders, M. Szegin, and J. M. Medero.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 23-32, 14 fig, 3 tab, 13 ref.

Descriptors: *Metal-finishing wastes, *Industrial wastes, *Metals, Wastewater treatment, Aluminum, Physicochemical treatment, Water pollution, Sludge, Sludge drying.

Studies are described which were conducted to evaluate the effects of segregated treatment techniques, neutralizing pH, sludge viscosity, temperature, suspended solids concentrations, form time, and applied vacuum on the dewatering and handling characteristics of sludges. Major findings and conclusions of the research project are outlined. Neutralization pH has a significant effect on the dewatering properties of sludges generated at 80 C; filter yield first increased in the pH range of 5.5 to 7.0 and then decreased with further increase in pH to 10. Dewatering properties of hydroxide sludges generated by segregated neutralization were significantly better than those of sludges generated by the conventional methods. A decrease of 86% in vacuum filter area, and a significant decrease in the amount of wet sludge for disposal, were observed when the sludge was generated at 80 C as compared to sludges generated at room temperature. (See also W88-00208) (Halterman-PTT)
W88-00211

DISPOSAL: WHAT DOES IT REALLY COST,
Aqualogic, Inc., Bethany, CT.
D. W. Smith, and C. H. Roy.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 43-48, 1 fig, 23 tab.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Financial aspects, Conservation, Physicochemical treatment, Water pollution, Sludge.

Cost figures for plating bath make-up costs, together with chemical treatment costs, sludge generation rates, and disposal costs, are presented. The need to motivate electroplaters to implement in-plant modifications to conserve water and chemicals, minimize sludge, and recover water and chemicals by a variety of methods, is emphasized. While some recovery technology is quite expensive, and possibly rejected on budgetary grounds, other inexpensive techniques are available. Indifference and lack of motivation on the part of many platers, which have inhibited serious consideration of improvements in wastewater treatment, are discussed. (See also W88-00208) (Halterman-PTT)
W88-00212

OILY WASTEWATER TREATMENT BY ELECTROCHEMICAL TECHNIQUES,
Stanley Works, New Britain, CT.
D. M. Yarema.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 52-54, 2 ref.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Electrochemistry, Oil wastes, Oily water, Oil pollution, Physicochemical treatment, Water pollution.

A proposed project to treat oily wastewater by an electrochemical technique is presented, and the reasons for the selection of this method, and the anticipated benefits, are discussed. Basic factors important in determining the method of treatment included: (1) the need to produce treated water of a quality high enough to meet regulatory requirements and for re-use in industrial washers; (2) the need for the treatment method to handle a waste stream variable in oil concentrations, surfactant level, and particulate contamination; (3) the need for a fully automated system requiring a minimum of operator attention; and (4) the need for a cost-effective system with regard to capitol and operating expense. Preliminary feasibility studies conducted in the laboratory indicated that an electrochemical technique could fulfill most of the needs and remove 99% of the oily wastes. The method is capable of treating oily wastewater from diverse machine operations, containing emulsified oils, surfactants and a combination of oils. (See also W88-00208) (Halterman-PTT)
W88-00213

CROSS FLOW FILTRATION TECHNOLOGY FOR METAL FINISHERS,
Hydronautics, Inc., Laurel, MD.
H. L. Liu, and J. Blacklidge.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 55-58, 3 fig, 2 tab, 3 ref.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Water pollution, Microfiltration, Membrane filtration, Ultrafiltration.

The results of wastewater treatment technology evaluation programs dealing with the application of a microfiltration system designed to treat industrial wastes containing heavy metals are discussed. The discussions focus on a lead-acid battery manufacturing wastewater system and a system for treating electroplating wastewater. Results indicate that cross-flow microfiltration is an effective treatment technology to serve as a unit process in the treatment train for industrial wastewaters containing heavy metals. The precipitated heavy metals formed by either caustic addition, as in the electroplating study, or lime addition, as in the battery study, can be easily separated from the wastewater if the pH is controlled. The quality of the treated

wastewater is sufficient to permit discharge to public waterways or to local waterworks. (See also W88-00208) (Halterman-PTT)
W88-00214

APPLICATION OF ION-EXCHANGE AND MODIFIED RINSING PROCEDURES TO MINIMIZE TREATMENT COSTS,
Raytheon Ocean Systems Co., East Providence, RI.
D. W. Kemp.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 59-63, 7 fig, 2 ref.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Physicochemical treatment, Water pollution, Gold, Silver.

Minimizing the quantity of process chemicals lost in the drag-out, and segregating residual drag-out loads into small rinse volumes, that can be recovered or treated in batch systems, are discussed as a cost-effective system for the treatment of metal finishing wastewater. Drag-out control, drag-out segregation, end-of-pipe treatment, and ion-exchange polishing are outlined. The design of a point source control system is presented, with emphasis on an automated line, the precious metal line and the wastewater treatment system. The discussions illustrate that process controls can be integrated into a process line to maximize recovery of chemicals and significantly reduce treatment costs. (See also W88-00208) (Halterman-PTT)
W88-00215

RECOVERY AND ELECTROCHEMICAL TECHNOLOGY,
Allied Metal Finishing, Inc., Baltimore, MD.
P. Horelick.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 66-69, 3 fig, 2 tab.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Electrochemistry, Electrolysis, Physicochemical treatment, Water pollution, Cadmium.

The practical aspects of high surface area (HSA) electrochemical reactor technology is discussed, with emphasis on operating performance and cost savings. Process water and pollution control techniques in use prior to the installation of the HSA reactor are also discussed. Of particular interest was the need to not only reduce costs and metal pollutant levels overall, but to reduce cadmium levels overall, but to reduce cadmium levels specifically. Data for pre-HSA reactor effluent levels of cadmium, aluminum, copper, zinc, nickel, iron, chromium, cyanide and lead are presented. The maximum cadmium discharge was 1.5 mg/L with a four-day average ranging from 0.45 to 0.82 mg/L. Data gathered after the new treatment processes were installed indicated that cadmium levels ranged from 0.22 to 0.43 mg/L. (See also W88-00208) (Halterman-PTT)
W88-00216

SOME SUCCESSFUL APPLICATIONS OF ELECTRODIALYSIS,
Lea Mfg. Co., Waterbury, CT.
W. G. Millman, and R. J. Heller.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 70-74, 6 fig, 6 tab.

Descriptors: *Electrodialysis, *Metal-finishing wastes, Industrial wastes, Metals, Wastewater treatment, Physicochemical treatment, Water pollution, Gold, Nickel, Chromium, Silver.

A brief discussion of the theory of electrodialysis is presented, followed by several examples of its application in the metal finishing industry. Some of the most successful applications have been on gold plating baths. Because of the high conductivity of plating solutions, gold recovery rates as high as 99% have been obtained. The use of electrodialysis in nickel, chrome, and silver plating is also outlined. The future of electrodialysis in the plating industry is discussed, and the current progress in the development of techniques to recover fluoborate and chrome plating solutions are mentioned. (See also W88-00208) (Halterman-PTT)
W88-00217

NEW DEVELOPMENTS FOR THE TREATMENT OF WASTEWATER CONTAINING METAL COMPLEXERS,
Enthone, Inc., New Haven, CT.
C. Courduvells, G. Gallager, and B. Whelan.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 77-80, 6 fig, 2 tab, 9 ref.

Descriptors: *Chelating agents, *Chelation, *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Physicochemical treatment, Water pollution.

The use of a commercial chelating resin. a cross-linked polystyrene bearing iminodiacetic acid functional groups, for removing metals from wastewater containing metal complexers is discussed. Areas where the process can be applied include electroless copper; etchants of printed circuits containing copper such as ammoniacal, persulfate or peroxide-based etchants and their rinses; electroless nickel (both the rinses and spent electroless nickel solution); and various electrolytic copper or nickel rinses and solutions. Several types of complexers that can be present during this process are listed. Experimental and field data which demonstrate the success of this process are presented and the advantages and disadvantages of metal removal systems are outlined. (See also W88-00208) (Halterman-PTT)
W88-00218

BATCH HYDROLYSIS SYSTEM FOR THE DESTRUCTION OF CYANIDES IN ELECTROPLATING EFFLUENTS,
Ontario Research Foundation, Mississauga.
R. G. W. Laughlin, H. K. Robey, and P. S. Gooderham.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 81-85, 5 fig, 5 tab, 7 ref.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Physicochemical treatment, Water pollution, Electrodialysis, Electrolysis, Cyanide, Electrochemistry.

Laboratory test results, from studies on electroplating systems designed for the destruction of cyanides present in effluents, are summarized. The design of the commercial scale demonstration unit is described. Hydrolysis was accomplished in a batch system for more concentrated cyanide wastes and in a continuous flow system for dilute rinse solutions. Cyanide destruction efficiencies of greater than 99.9% were achieved at temperatures ranging from 150-250 C on a variety of different plating wastes. As a follow-up to this project, the American Electroplaters' Society is supporting a commercial demonstration of the batch system. This plant is being built by WetCom Engineering Ltd. and will be installed and tested at Whyco Chromium Co. Inc. in Thomaston, Connecticut, early in 1982. (See also W88-00208) (Halterman-PTT)
W88-00219

RENOVATION OF ELECTROPLATING RINSE WATERS WITH COUPLED-TRANSPORT MEMBRANES,
Bend Research, Inc., OR.
W. C. Babcock, E. D. LaChapelle, and R. W. Baker.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 86-90, 10 fig, 1 tab, 12 ref.

Descriptors: *Metal-finishing wastes, *Industrial wastes, Metals, Wastewater treatment, Physicochemical treatment, Water pollution, Electrodialysis, Electrolysis, Electrochemistry.

A new membrane process is described that can be used to recover plating chemicals from electroplating rinse waters. The process, called coupled transport, is based on liquid membranes that are comprised of a thin, polymeric microporous support containing a metal-ion complexing agent within the pores. Metal ions present in the rinse solutions are transported across these membranes and can be concentrated into a relatively small volume. The results of a small-scale field test are presented in which hollow-fiber coupled-transport membranes were used to recover chromium from chromeplating rinse waters. The results of a 125-day test are used as the basis of an economic analysis that predicts a 1.7-year payback period for a full-sized coupled-transport unit. (See also W88-00208) (Author's abstract)
W88-00220

APPLICATION OF DONNAN DIALYSIS TO ELECTROPLATING WASHWATER TREATMENT,
Southwest Research Inst., San Antonio, TX.
H. F. Hamil.
IN: Fourth Conference on Advanced Pollution Control for the Metal Finishing Industry, January 18-20, 1982, Dutch Inn, Lake Buena Vista, Florida. EPA-600/9-82-022, Industrial Environmental Research Lab.-Cincinnati, Ohio, December 1982. p 91-94, 10 fig, 4 ref.

Descriptors: *Metal-finishing wastes, *Industrial wastes, *Metals, Wastewater treatment, Physicochemical treatment, Water pollution, Electrodialysis, Electrolysis, Electrochemistry.

The operation of a Donnan dialyzer as a means of removal of ionic contamination from electroplating washwaters is discussed. The application of both anion-exchange and cation-exchange membranes for treatment of waste streams from various metal plating lines is considered. The on-going development of a field prototype Donnan dialyzer for removal of complex metal-cyanide anions from cyanide bath process washwaters is discussed. The dialyzer will be operated on washwaters in commercial electroplating shops to provide engineering data on membrane performance and on long-term stability of the membranes under actual use conditions. The field data obtained should also allow assessment of the cost effectiveness of Donnan dialysis as a means of controlling effluent emissions levels in electroplating process wastewater discharges. (See also W88-00208) (Author's abstract)
W88-00221

SEWAGE SLUDGE STABILISATION AND DISINFECTION.
Water Research Centre, Stevenage (England).
Ellis Horwood Ltd., Chichester, England, 1984. Edited by A. M. Bruce. Ellis Horwood Series: Water and Wastewater Technology. 624 p.

Descriptors: *Reviews, *Sludge digestion, *Sludge disposal, *Anaerobic digestion, *Aerobic digestion, *Activated sludge process, Sludge, Sludge thickening, Sludge utilization, Sludge drying, Sludge filters, Sludge conditioning, Wastewater treatment, Digested sludge, Economic aspects, Activated sludge, Stabilization lagoons, Chemical treatment, Biological wastewater treatment.

Many of the items discussed in this book are of current relevance, both on a national and international level, especially with regard to the environmental hazards involved in the utilization of sewage sludge in agriculture, and also with respect to the measures required to minimize the risks to human and animal health. In addition, the economic and energy utilization aspects of sludge digestion and stabilization techniques are considered. The comprehensive coverage of major new developments includes: high rate anaerobic digestion; prefabrication of digesters; heating and cooling techniques; autothermic digestion using oxygen and air, as well as dual digestion; lime stabilization; composting and pasteurization techniques; chemical disinfection methods; and irradiation. The reviews included in this book cover methods of assessing sludge stability and the effectiveness of disinfection with respect to utilization of sewage sludge in agriculture. There are summary discussions of all the major topics, a detailed index, and illustrations and photographs of treatment plants. (See W88-00238-W88-00269) (Geiger-PTT)
W88-00237

SLUDGE STABILISATION - METHODS AND MEASUREMENT,
Water Research Centre, Stevenage (England).
A. M. Bruce, and W. J. Fisher.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 23-47, 2 fig, 3 tab. 42 ref.

Descriptors: *Sludge digestion, *Sludge conditioning, *Anaerobic digestion, *Aerobic digestion, *Stabilization lagoons, Sludge, Sludge thickening, Sludge utilization, Sludge drying, Wastewater treatment, Odor, Digested sludge, Activated sludge process, Chemical treatment, Biological wastewater treatment, Oxygen demand, Chemical oxygen demand.

Sludge stabilization methods are used principally for odor control, but they provide other benefits such as pathogen reduction. Methods for stabilizing sewage sludge may be divided broadly into biological processes which effect some degree of permanent stabilization, and chemical treatments which may be either temporary or permanent in stabilization. Mesophilic anaerobic digestion is the most important method of stabilization. It can operate at heats of 30 to 37 degrees, and has less odor than thermophilic digestion processes. Autothermic aerobic digestion may be an attractive method, especially where pasteurization is required. Composting is unlikely to have much significance in the future, at least in the United Kingdom. Chemical stabilization will be confined mainly to lime addition. There is no standard method for measuring sludge stability and it seems unlikely that one of general, routine applicability will be developed. Odor measurements are not suitable for routine use and are difficult to interpret. The use of 'fractions of volatile solids destroyed' as a method of measuring sludge stability must be regarded with caution. Other methods of measuring sludge stability include calculating volatile fatty acids, oxygen demand, nitrate levels, pH value, evolution of hydrogen sulfide or biological activity. Some of these methods are applicable only to particular stabilization methods. (See also W88-00237) (Geiger-PTT)
W88-00238

SLUDGE DISINFECTION - AN OVERVIEW OF METHODS AND THEIR EFFECTIVENESS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
A. H. Havelaar.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 48-60, 1 fig, 1 tab, 26 ref.

Descriptors: *Disinfection, *Composting, *Irradiation, *Lime, *Heat treatment, Sludge, Sludge conditioning, Wastewater treatment, Digested sludge, Anaerobic digestion, Aerobic digestion, Activated sludge process, Activated sludge, Stabilization lagoons, Chemical treatment, Biological wastewater treatment, Pathogenic bacteria, Viruses, Parasites, Pathogens, Spores.

A brief overview of several sludge disinfection methods is given. Pasteurization uses temperatures of 70 degrees to give good control of bacteria and parasites, variable control viruses, and poor control of spores. The product stability after pasteurization is poor, and the process must be combined with stabilization methods. Irradiation uses ionizing radiation (300 kilorad) to provide good control of bacteria, good to moderate control of parasite eggs, and poor control of viruses and spores. The product stability after irradiation is variable and the process must be combined with other stabilization techniques. Aerobic thermophilic stabilization in oxygen uses heat (60-80 degrees) to give good control of bacteria, viruses, and parasite eggs, but poor control of spores. Depending upon mixing characteristics, the product stability after aerobic thermophilic stabilization in oxygen or air is probably good. Aerobic thermophilic stabilization in air relies on heat (40-60 degrees) to yield good control of bacteria and parasites, poor to good control of viruses and poor control of spores. Composting carried out in windrows or bioreactors gives good sludge stability. The heat effects of composting depend on turning and climate. Lime treatment with slaked or quick lime gives good control of bacteria, moderate to good control of viruses, and variable to good control of parasite eggs. The infectivity of some parasitic eggs may be destroyed by the high pH of lime treatment, and product stability is good if pH remains >10. (See also W88-00237) (Geiger-PTT)
W88-00239

DESIGN ASPECTS OF THE NEW ANAEROBIC DIGESTERS AT BURY,
Binnie and Partners, London (England).
J. L. Thompson, and A. P. Michaelson.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 92-106, 5 fig, 1 tab, 5 ref, append.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Design criteria, *Wastewater facilities, *Sewage sludge, Sludge conditioning, Sludge, Digested sludge, Digestion, Wastewater treatment, Biological wastewater treatment, Cost analysis.

This chapter outlines the steps that have been taken in the design of a new anaerobic sludge digestion plant at Bury. Design objectives sought to make the rate of feeding and mixing in the digesters as near continuous as possible. Also, a height/diameter aspect ratio significantly greater than unity was planned to allow the highest volume of gas to be generated per unit area of tank. Plans for heating of the digesters involved a separate heating/mixing circuit. Sludge pipelines were designed to allow hydraulic turbulence to prevail at normal operating flow rates. Since digester temperature is the main process control parameters, temperature measurements are taken at mid-height in the digester to maintain the selected operating temperature at 35 degrees. During final plan implementations, and unconfined gas bubble mixing system was chosen over the heating/mixing circuit because the former was less expensive to operate. A commissioning program will be carried out to check that plant performance is in line with the guarantees. (See also W88-00237) (Geiger-PTT)
W88-00241

PROGRESS IN ANAEROBIC DIGESTION - PREFABRICATION OF DIGESTERS,
Severn-Trent Water Authority, Birmingham (England).
G. P. Noone, C. E. Brade, and J. Whyley.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 107-124, 5 fig, 3 tab, 16 ref, append.

Descriptors: *Fabrication, *Anaerobic digestion. *Sludge digestion, *Wastewater facilities, *Construction materials, Construction, Digestion, Cost analysis, Economic aspects, Design criteria.

Prefabricated structures were first applied to mesophilic anaerobic digestion in the farming and food processing industry. The smaller populations serviced by small self-sufficient facilities make prefabricated structures an attractive low-cost option for mesophilic anaerobic digestion. The approach offers great speed of provision and increased operational flexibility within regional water authorities. The lower detention periods and greater attention to plant control and process inputs result in plants with high reliability. The alternative materials available for tanks up to 30 ft in diameter include mild steel/bolted, galvanized steel/bolted, wood, glassfiber reinforced plastics, epoxy/rubber lined steel, aluminum/stainless steel, and reinforced concrete. There are further significant potential cost savings to be gained within the United Kingdom Water Industry by further applications of the standardized modular approach based upon maximum off-site assembly. Further technical developments should hinge around refinement of the chosen equipment and tank geometry. (See also W88-00237) (Geiger-PTT)
W88-00242

AUTOMATION AND UPRATING OF ANAEROBIC DIGESTERS,
Anglian Water Authority, Norwich (England). Norwich Sewage Div.
J. Hemsley, and A. Latten.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 125-141, 2 fig, 4 tab, 16 ref.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Automation, *Digested sludge, Sludge disposal, Wastewater facilities, Wastewater treatment, Digestion, Computers, Process control, Sludge conditioning, Biological wastewater treatment, Sludge, Cost analysis, Design criteria.

The operational performance of the Ames Crosta Mills heated anaerobic sludge digestion plant at Norwich is reviewed. The superimposed computer control system satisfactorily approximates to continuous feeding. Through this approach an effective sludge retention period of 13.4 days yielded no operational problems in the digestion process. It is recommended that digestion plants be designed using a combination of hydraulic retention period and organic solids loading factor. The equipment should be efficient enough to provide for constant homogeneity and prevent grit deposition. The process should be optimized by both pre- and post-thickening of sludge with an objective feed sludge solids content of 6%, coupled with the use of gas stripping technique on digested sludge for up to approximately 4 hours depending on initial solids content, followed by quiescent settlement for up to seven days. The value of digester gas in either space heating or power generation is a vital consideration which should never be overlooked. (See also W88-00237) (Geiger-PTT)
W88-00243

FULL SCALE COMPARISON OF THE CONFINED AND UNCONFINED GAS LIFT MIXING SYSTEMS IN ANAEROBIC DIGESTERS,
W. D. Carroll, and R. D. Ross.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 146-157, 4 fig, 10 ref.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Mixing, *Comparison studies, *Radioactive tracers, Digestion, Automation, Wastewater facilities, Wastewater treatment, Process control, Sludge conditioning, Digested sludge, Biological wastewater treatment, Cost analysis, Design criteria, Radioisotopes.

The City of Winnipeg Waterworks, Waste and Disposal Department initiated investigations into alternative tank mixing systems and suitable sludge grinding systems for the North End Water Pollution Control Center. Mixing efficiencies of a primary digester equipped with new mixing equipment, and a primary digester equipped with an existing Pearth gas recirculation mixing system were evaluated using tracer response techniques. The loading and overall efficiency and effectiveness of the primary digesters was also examined. Tracer washout data for the two full-scale anaero-

bic digester systems evaluated indicate that the digester equipped with the Aero-Hydraulics confined gas lift system had superior mixing compared to the digester equipped with the Pearth unconfined gas lift system. The former system had a 98% actively mixed volume while the latter showed a 57% mixed volume. The low recoveries and high background levels found using sodium fluoride as a tracer are felt to be limitations to its usefulness. The use of radioisotopes such as Na24 used by other investigators should be examined for use in follow-up studies. Further study on the Aero-Hydraulics system should be conducted after several years operation to determine if any deterioration in mixing efficiency occurs with time. (See also W88-00237) (Geiger-PTT)
W88-00244

PROGRESS IN ANAEROBIC DIGESTION - HEATING, COOLING, AND THICKENING,
Severn-Trent Water Authority (England).
C. E. Brade, G. P. Noone, and J. Whyley.
IN: Sewage Sludge Stabiliation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 158-173, 2 tab, 14 ref, 2 append.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Sludge drying, *Sludge conditioning, *Sludge thickening, Wastewater facilities, Wastewater treatment, Digestion, Dewatering, Sludge, Sewage sludge, Biological wastewater treatment, Design criteria, Heating, Heat transfer, Cooling, Water cooling.

Many systems are available for heating sludge in anaerobic digestion processes, including hot water heat exchanger in circuits, direct injection of steam, reuse of heat recovered from the discharged hot sludge, as well as submerged combustion. Hot water heating systems can utilize internal or external heat exchange. Steam injection options include single or multi-point injection systems. Multi-point injection (steam) heating may be used in conjunction with separate gas mixing. Sludge cooling is needed for heat recovery, particularly in the operation of heat treatment plants or thermophilic digestion. It is also a requirement for the consolidation of digested sludge. The design and preliminary operating performance of a water cooling system at the Rainworth digestion plant is described. Sludge consolidation or thickening is usually performed by gravity techniques. At the Rainworth plant, manual pumped desludging of sedimentation tanks is carried out. The separate consolidation of raw sludge in tanks designed for thickening and the operating experience of full-scale picket fence stirrer consolidation at Sutton-in-Ashfield are described. (See also W88-00237) (Geiger-PTT)
W88-00245

CONTROL OF THE ANAEROBIC DIGESTION PROCESS,
Water Research Centre, Stevenage (England).
F. E. Mosey, and M. Foulkes.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 174-195, 8 fig, 7 tab, 18 ref.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Process control, *Digested sludge, *Monitoring, Alkalinity, Sludge, Wastewater treatment, Digestion, Activated sludge process, Biological wastewater treatment, Methane, Grease, Fermentation.

This chapter provides baseline data concerning the performance of the anaerobic digestion process for the stabilization of sewage sludges, together with a description of the self regulating features of methane fermentation and a critical assessment of the process parameters normally used to monitor its performance. Steady-state performance data is measured according to gas yield and volatile acid concentrations, methane content of the digester gas, destruction of solids, fats and greases, and N balance and formation of pH buffer. Self-regulating features of the anaerobic digestion process include control for the pH value by ammonium bicarbonate buffer, titrations for determination of volatile fatty acids alkalinity, total alkalinity and bicarbonate alkalinity, control of gas composition, and monitoring short-term fluctuations in gas composition. Other self-regulating features include control of the redox potential of the digesting sludge, and monitoring of trace concentrations of hydrogen gas in digester gases. The most rapid and reliable method of initiating methane fermentation is to fill the digestion tank with actively digesting sludge, heat it to the required temperature and then feed raw sludge into the digestion tank. Acid-overloads can be corrected by sodium bicarbonate additions. Frothing and foaming are controlled by temporarily arresting the feeding of raw sludge. Some common inhibitors of the anaerobic digestion process are anionic detergents, several organic solvents, and some metals. (See also W88-00237) (Geiger-PTT)
W88-00246

DESIGN AND OPERATION OF ANAEROBIC SLUDGE DIGESTERS IN GERMANY,
K. R. Imhoff.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 210-233, 23 fig, 2 tab, 26 ref.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Design criteria, *Digested sludge, *Wastewater facilities, Sludge conditioning, Sludge, Activated sludge, Activated sludge process, Digestion, Wastewater treatment, Biological wastewater treatment, Cost analysis, Sewage sludge, Aeration, Operating costs.

Since 1924, it was realized in Germany that the process of anaerobic digestion works faster at higher temperatures. The design of the digestion tank was revolutionized in the 1950's with the development of a functional, smoothly curved container shape which could be manufactured economically in four or six segments. Digester gas was recovered in Germany as early as 1922. The volume of digesters is generally calculated for a temperature of 37 degrees and a digestion period of 20 days. The volume of sewage sludge to be treated is based largely upon the dry matter concentrations to be attained after treatment. The construction forms of the 50-yr-old digesters in Essen-Rellinghausen, one with a flat bottom and scraping mechanism, the other with a conically sloping bottom are still competitive today. Additional thermal stresses resulting from the changeover from mesophilic to thermophilic operations can be handled by building thicker walls. Digester installations must have devices for the input of the crude sludge, the drainage of the digested sludge, emergency overflow, an outlet with safety valve for the digestion gases, outlet for the scum, circulation of the contents and for heating the sludge. The start-up of the digester involves innoculation of the tank with sludge from a neighboring plant operating at the same temperature. Over 50% of the electrical energy requirements of the wastewater treatment plant are taken up by the compressed air aeration of the activated sludge stage. (See also W88-00237) (Geiger-PTT)
W88-00247

ACCELERATED COLD ANAEROBIC DIGESTION,
Yorkshire Water Authority (England).
P. Lowe, and S. M. Williamson.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 224-238, 6 fig, 3 tab, 5 ref.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Wastewater facilities, *Digested sludge, *Activated sludge process, *Digestion, Sludge conditioning, Design criteria, Sludge, Activated sludge, Wastewater treatment, Biological wastewater treatment, Cost analysis, Anaerobic lagoons, Sludge lagoons, Sewage sludge.

A series of experiments was conducted to study the possibility of producing a sludge having similar physical and chemical characteristics to the Calder Vale mesophilic digested sludge within the 90-day retention period of the storage lagoon capacity. From the laboratory work, it was concluded that sludge could be fully digested if raw sludge and mesophilic digested sludge were mixed together in an appropriate ratio of 1:1 by dry solids weight, before storage of the mixture in the lagoons, and that a modified application of the technique may be useful for small sewage works. Two plants within 10 km of Calder Vale, the Crofton and the Great Cliff, were selected for the trials. The work at these two plants indicated that, if better mixing of the raw and digested sludge could be achieved, it may be possible to intensify the process. To test this theory, a lagoon was constructed at the Ackworth Works along with a circular mixing tank. Results showed that there is a possibility of intensifying the 90-day process even further by the provision of adequate mixing providing the ratio of raw to digested sludge is carefully controlled. Since storage at small works is more dependent upon providing sufficient sludge to make its application to a nearby field economically viable and acceptable to the farmer, it is likely that this capacity will need to be well in excess of the 90 days recommended for medium and large works. Where tankering of raw sludge to a centralized works is practiced, further revenue savings can be accrued. (See also W88-00237) (Geiger-PTT)
W88-00248

CONSOLIDATION OF DIGESTED SLUDGE,
Thames Water Authority, London (England).
B. J. E. Hurley, A. J. Rachwal, and C. J. Hatton.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 239-255, 8 fig, 5 tab, 10 ref.

Descriptors: *Sludge thickening, *Sludge drying, *Sludge digestion, *Digested sludge, *Anaerobic digestion, Digestion, Wastewater treatment, Sludge conditioning, Dewatering, Aeration, Aerators, Liquid, Sludge solids, Cost analysis.

Digested sludge has been relatively difficult to consolidate in secondary digesters/thickeners with more than half being disposed of in the UK without any substantial thickening at a dry solids content of only 2.5%. Consolidation of all digested sludge to at least 5% solids could reduce the annual sludge disposal volume by 5 to 9 million cu m. The storage capacity of deep, secondary digesters or thickeners is <50% of the 50 to 100 days retention needed to achieve 50% consolidation at most UK works. Shallow digested sludge thickeners allow more rapid consolidation. Pre-aeration of digested sludge (AERCON process) improves the rate of consolidation. Aeration is believed to aid digested sludge consolidation by gas stripping of microbubbles and dissolved gases which hinder settlement. Further production of methane gas is inhibited by a rise in pH to above 8.0 resulting from gas stripping CO2 from solution. Full-scale tests have been conducted on a number of digested sludge aeration devices (coarse bubble aeration grids, venturi aerators, submerged turbines, surface aeration cones and supernatant draw off pipework). Optimum conditions varied with initial sludge conditions, aeration tank geometry and scale of operation. Low intensity aeration or prolonged aeration at high intensity were found to be deleterious to subsequent consolidation. Using preaeration to improve consolidation could result in overall net savings of 25 to 35% of current sludge disposal costs. (See also W88-00237) (Geiger-PTT)
W88-00249

EXPERIENCES WITH LIME STABILISATION AND COMPOSTING OF SEWAGE SLUDGE,
Norsk Inst. for Vannforskning, Oslo.
B. Paulsrud, and A. S. Eikum.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 261-277, 8 fig, 5 tab, 13 ref.

Descriptors: *Lime, *Sludge conditioning, *Sludge drying, *Dewatering, *Composting, Sludge, Odor, Aeration, Disinfection, Wastewater treatment, Sewage sludge, Sludge solids, Liquid sludge.

Lime stabilization reduces odor and the amount of pathogens in sludges. In Norway, two different techniques for lime treatment have been introduced: addition of hydrated lime to undewatered

sludge (before or after thickening); and the addition of quicklime to dewatered sludge. The filtration properties of lime stabilized sludges generally improved with increasing lime addition. Lime additions sufficient for stabilization will not give proper conditioning for dewatering by filtration. The drainage rate of lime-stabilized sludge will increase with increasing lime dosages, but will decrease again during storage. Primary sludge needed higher additions of a cationic polymer with increased lime dosage, while the opposite was true for mixed primary-chemical (alum) sludge and mixed biological-chemical (alum) sludge. Three modes of composting of sewage sludge are in operation in Norway: windrow or heap composting without bulking agents; aerated pile composting without bulking agents; and reactor composting with bulking agents. The windrow process without addition of bulking agents is suitable for small and medium size sewage treatment plants. A new sewage treatment plant in Oslo and two neighboring municipalities have adopted the aerated pile composting method for processing about 10,000 tons of dry solids per year. Results of reactor composting with bulking agents show that the process has mechanical and disinfection problems. (See also W88-00237) (Geiger-PTT)
W88-00250

AEROBIC THERMOPHILIC DIGESTION OF SLUDGE USING AIR,
Electricity Council Research Centre, Capenhurst (England).
S. F. Morgan, H. G. Gunson, M. H. Littlewood, and R. Winstanley.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 278-292, 2 fig, 9 tab, 11 ref.

Descriptors: *Aerobic digestion, *Sludge digestion, *Aeration, *Digestion, *Design criteria, Wastewater treatment, Aerators, Odor, Disinfection, Pathogens, Sludge drying, Dewatering, Sludge thickening, Cost analysis, Performance evaluation, Wastewater facilities, Sludge soils.

This chapter reports on the design and initial operation and performance of the aerobic digestion system at the Ponthir Sewage Treatment Works of the Welsh Water Authority. Operation objectives were to operate a thermophilic aerobic sludge digester with air, to use a non-specific unlagged tank as digester, and to function at full-scale within an operational sludge handling system. Aeration was performed by three VO2 Venturi aerators. Soon after aeration commenced, a foam blanket covered the liquor surface. Odor was controlled soon after commissioning. Sludge temperature remained at 37 degrees above ambient. Reduction in COD and solids were generally well within the target figures. Loading rates of 6.8 and 15.7 kilograms COD/day cu m of reactor were accompanied by removal rates of 3.1 to 8.6 kilograms COD/day cu m. The VO2 system provided excellent oxygen transfer and mixing for thermophilic aerobic digestion with air. Dewatering of sludge deteriorated during treatment. The digester at Ponthir consumed 12.5 to 18.9 kilowatt-hr/cu m of sludge treated. For future aerobic thermophilic digestion systems, it was recommended that minimum reactor temperature be kept at 50 degrees (for adequate control of pathogens), sludge depth be a maximum of 6.5 m, sludge be dewatered prior to digestion, and a feedstock sludge holding tank be provided adjacent to the digester. It is also suggested that airflow be controlled by an oxygen meter. (See also W88-00237) (Geiger-PTT)
W88-00251

THERMOPHILIC SLUDGE DIGESTION USING OXYGEN AND AIR,
Wessex Water Authority, Bristol (England).
M. G. Booth, and E. Tramontini.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 293-311, 4 fig, 7 tab, 11 ref.

Descriptors: *Sludge digestion, *Aeration, *Oxygen, *Aerobic treatment, Wastewater treatment, Aerators, Odor, Disinfection, Pathogens, Sludge drying, Dewatering, Sludge thickening, Cost analysis, Performance evaluation, Wastewater facilities, Digested sludge, Digestion, Design criteria, Pathogenic bacteria, Sludge conditioning, Aerobic conditions, Aerobic digestion.

The aerobic digester at the Palmersford sewage treatment plant was used to test the thermophilic digestion of sludge using oxygen and air. The digester was operated under three different conditions: at a ten-day retention time with sufficient oxygen supplied to achieve thermophilic conditions, with increased oxygen supply to improve sludge quality, and at a five-day retention time. Raw and digested sludge samples were taken every day and analyzed in the site laboratory for pH, total solids, and volatile solids. From analysis of results of the project it was concluded that the temperature of the digester was self-sustaining in the thermophilic range. At these temperatures, virtually all pathogenic bacteria were eliminated. The destruction of volatile solids ranged from 17.5 to 25%, although high levels of chemical oxygen demand were satisfied. Oxygen utilization varied between 2.03 to 4.21 kilograms oxygen used/kilograms volatile solids destroyed. Oxygen utilization ranged from 65 to 87%. Automatic control systems designed to improve the oxygen utilization efficiency have worked successfully due to the unreliability of dissolved oxygen measurement in sludge at 60 degrees. Combined use of pure oxygen and air is theoretically feasible and would lead to reduced operating costs. At Palmersford, the digested sludge was not odor-free and exhibited poor consolidation. (See also W88-00237) (Geiger-PTT)
W88-00252

RECENT DEVELOPMENTS IN SLUDGE DIGESTION IN THE UNITED STATES AND A VIEW OF THE FUTURE,
Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
J. B. Farrell.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 317-329, 3 fig, 2 tab, 12 ref.

Descriptors: *Anaerobic digestion, *Aerobic digestion, *Sludge digestion, *Digestion, *Design criteria, Wastewater treatment, Sludge drying, Dewatering, Sludge thickening, Cost analysis, Performance evaluation, Wastewater facilities, Digested sludge, Sewage sludge, Sludge conditioning, Sludge utilization.

The EPA Innovative and Alternative (I/A) Technology Program has spurred recent interest in sludge digestion processes. Under the I/A program, anaerobic digestion projects qualify as alternative technology if they utilize the methane generated in a constructive fashion. Thermophilic digestion is practiced in one of the digesters at the City of Los Angeles's Hyperion Plant. Chicago has recently proceeded with plans to expand greatly its mesophilic digestion capacity. A full-scale EPA-supported demonstration of aerobic-anaerobic digestion has been carried out in Hagerstown, Maryland with considerable success. Two-phase digestion, in which sludge is digested is two vessels in series in order to separate hydrolysis or acid-phase digestion from the methanogenic phase of digestion will be applied on a large scale in Kansas City, Missouri. The multiple digestion process was demonstrated on a large scale at New York City's Rockaway sewage treatment plant. New plants under construction or in design at New York City will be equipped to run in the multiple regression mode. There has been substantial research and development activity in the Los Angeles area related to digestion. The utilization of the energy produced by the digestion process to operate essential parts of the plant will now make digestion a very important process. Research priorities for anaerobic digestion are listed. (See also W88-00237) (Geiger-PTT)
W88-00253

DIGESTER GAS - AN ENERGY RESOURCE,
Yorkshire Water Authority (England).
D. C. Bartlett.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 330-342, 3 fig, 1 tab, 42 ref.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Energy sources, *Methane, *Sludge utilization, Energy, Wastewater treatment, Dewatering, Fuel, Sludge thickening, Cost analysis, Digested sludge, Digestion, Sewage sludge, Sludge conditioning.

The utility of heated anaerobic digestion biogas has been recognized for many years. In comparing the strategies which exist for biogas utilization as a fuel source, energy analysis provides a most useful complement to conventional financial analysis. The result of an energy analysis is a set of gross energy requirements (GER) for all of the commodities produced. Thus the utilization of biogas may be assessed in relation to the GER value anaerobic digestion. The use of on-site combined heat and power (CHP) systems utilizing biogas as the fuel source should be evaluated within the context of suitable heat demand and its proximity. The cost of generating electricity with CHP systems, operating at high utilization factors, has been calculated at <2 pence per kWh and this allows for capital, installation, maintenance, consumables and standby payments to the area electricity board. Biogas strategies may also be affected by off-site demand, in that the export of product may positively influence plant utilization and therefore the financial break-even point. The enhancement of sludge acceptability, coupled with any decrease in the sludge volume gained through post-digestion thickening may reduce the off-site ton-kilometers, and consequently the overall financial and energy budget. (See also W88-00237) (Geiger-PTT)
W88-00254

ECONOMIC ASSESSMENT OF SOME METHODS OF SEWAGE SLUDGE STABILISATION,
Water Research Centre, Stevenage (England).
W. J. Fisher.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 343-363, 14 fig, 2 tab, 11 ref, append.

Descriptors: *Cost analysis, *Sludge digestion, *Economic aspects, *Comparison studies, *Sludge lagoons, Lime, Sludge conditioning, Anaerobic digestion, Aerobic digestion, Digested sludge, Sewage sludge, Sludge utilization, Stabilization lagoons, Dewatering, Sludge drying.

The economics of various methods of sludge stabilization (anaerobic digestion, sludge lagooning, aerobic digestion, lime stabilization, and sludge dewatering and stacking) are examined and compared in terms of net present value (NPV). Calculations were made for each combination of processes for each of six sizes of sewage treatment works for on-site items, on-site items plus transport involving a round-trip journey of 10 km, and on-site items plus transport involving a round-trip journey of 50 km. For the general cases considered, it was concluded that the potential cost advantage in using treatment lagoons is high, and that their design and operation ought to be considered in detail. Reduction of retention period, alone, in conventional anaerobic digestion has little effect on the overall NVP. Pre-thickening is more worthwhile because of consequent reductions in transport costs. The use of prefabricated plants has an even more worthwhile effect. Aerobic digestion will probably be competitive only after thickening. Dewatering and stacking is of limited potential because of its costs. Lime stabilization is economically attractive, but guidelines on lime sludge use may restrict its utilization. Pasteurization followed by anaerobic digestion is less expensive than thermophilic aerobic digestion. Use of biogas from anaerobic digestion is unlikely to greatly affect the economic status of the process. (See also W88-00237) (Geiger-PTT)
W88-00255

EFFECT OF ANAEROBIC DIGESTION TEMPERATURE AND RETENTION PERIOD ON THE SURVIVAL OF SALMONELLA AND ASCARIS OVA,
Water Research Centre, Stevenage (England).

E. G. Carrington, and S. A. Harman.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 369-380, 1 fig, 4 tab, 16 ref.

Descriptors: *Parasites, *Salmonella, *Sewage sludge, *Anaerobic digestion, *Disinfection, Eggs, Larvae, Bacteria, Enteric bacteria, Coliforms, Digested sludge, Digestion, Temperature, Retention time.

The control of Salmonella and Ascaris ova by anaerobic digestion was examined in four digesters filled with actively digesting sludge. Duplicate digesters were operated at each of two retention periods of 10 and 20 days at 48 degrees and each of three retention periods of 10, 16, and 20 days at 35 degrees to test the control of Salmonella duesseldorf. Duplicate digesters were operated at each of three sludge retention periods (10, 16, and 20 days) and at each of two temperatures (35 and 49 degrees) to evaluate the control of Ascaris suum ova. Results showed that decay rates for Salmonella were greater at the higher temperature of 48 degrees. The decay rate at both temperatures were lower when the retention period was 10 days than when it was 20 days, but the rates for retention periods of 16 and 20 days at 35 degrees were similar. A greater decay rate was demonstrated for lower doses of salmonella. A slightly lower proportion of the ova added were recovered from the digesters operating at 49 degrees than from those at 35 degrees. The length of the retention period did not appear to affect the numbers of ova recovered. At 49 degrees, the proportion of recovered ova able to develop to the eight-celled undifferentiated stage appears to be related to retention period but no consistent trend appears in the results at 35 degrees. The action of digestion appears to inhibit the mechanism controlling the development of organs or larvae within the egg without inhibiting initial cell division. (See also W88-00237) (Geiger-PTT)
W88-00256

EXPERIENCES WITH THE PRE-PASTEURIZATION OF SEWAGE SLUDGE WITH HEAT RECOVERY,
Huber Enviro Consult A.G., Belp (Switzerland).
For primary bibliographic entry see Field 5E.
W88-00257

PASTEURIZATION BY SUBMERGED COMBUSTION TOGETHER WITH ANAEROBIC DIGESTION,
Severn-Trent Water Authority (England). Upper Severn Div.
R. J. Kidson, and D. L. Ray.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 399-408, 1 tab, 5 ref.

Descriptors: *Pasteurization, *Heat treatment, *Disinfection, *Sewage sludge, *Methane, Design criteria, Anaerobic digestion, Sludge digestion, Digestion, Heat transfer, Wastewater treatment, Biological wastewater treatment, Salmonella, Parasites, Sludge utilization, Digested sludge.

A new plant which uses submerged combustion of digester gas has been designed to establish minimum conditions for effective pasteurization of sewage sludge by a combination of flash heating with comminution, short-term retention at elevated temperature, and anaerobic mesophilic digestion. The plant is capable of instantly increasing sludge temperature to 55 degrees with an efficiency of heat transfer of about 90%, of maintaining it at least 3 hours at that temperature, and of feeding digesters either continuously or intermittently. The digesters may be operated in series or parallel and retention time may be varied from 12 to 36 days. Preheating for three hr at 55 degrees is probably sufficient to destroy both Salmonella and Taenia ova. The necessary heat energy for both disinfection and stabilization may be obtainable from the methane produced from digestion. Anaerobic digestion would serve as an additional disinfection measure. Alternatively, it may be possible to reduce the pre-digestion temperature and make additional methane available for alternative uses. (See also W88-00237) (Geiger-PTT)
W88-00258

EFFECTIVENESS OF CHEMICAL DISINFECTION ON FAECAL BACTERIA IN SLUDGE,
North West Water Authority, Preston (England).
A. F. Godfree, F. Jones, M. Satchwell, and D. C. Watson.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 412-425, 5 fig, 3 tab, 9 ref.

Descriptors: *Hydrogen ion concentration, *Sewage sludge, *Disinfection, *Chemical treatment, *Lime, Parasites, Eggs, Bacteria, Enteric bacteria, Salmonella, Digestion, Digested sludge, Anaerobic digestion, Coliforms.

Experiments were carried out to determine the effect of raised pH in sewage sludge on the viability of Salmonella. Results showed that with a contact time of 15 minutes there was a marked reduction in the number of salmonella when the pH was raised above 9. At pH 11.5, a reduction in Salmonella numbers in excess of 99% was obtained. Parallel experiments were carried out to study the effects of lime treatment on the viability of ova of Taenia saginata. Results showed that at pH 11.5, hatching of T. saginata ova is reduced from 35% to 0.6% after 4 hr exposure. At pH 12 hatching is reduced to 0.75% of eggs examined after only 2 hr contact time. The effectiveness of DF 955 and Proxitane 4002 as disinfecting agents of sewage sludges was also examined in laboratory and field investigations. Results for DF 955 demonstrated that if used at a concentration of 1% (by volume) in sludge with a contact period of not less than 1 hr, extremely high levels of Salmonella organisms would be destroyed, with no adverse effects on plant species or the soil invertebrate populations. Results for Proxitane 4002 showed that this product can be used at a concentration of between 500 and 1000 milligram/liter to treat sewage sludge with minimal contact periods (10 minutes) to produce significant bactericidal and ovicidal properties. (See also W88-00237) (Geiger-PTT)
W88-00259

EFFECTIVENESS OF CHEMICAL DISINFECTION ON PARASITES IN SLUDGE,
Liverpool School of Tropical Medicine (England).
R. R. Owen.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 426-439, 4 tab.

Descriptors: *Parasites, *Eggs, *Sewage sludge, *Disinfection, *Chemical treatment, Sludge disposal, Land application, Land disposal, Lime, Hatching, Sludge, Ammonium compounds.

The disinfection of sewage sludge destined for land application was examined in laboratory tests. Chemical disinfectants were evaluated for their ability to inhibit the growth of ova of Taenia and Ascaris in water. A two-phase in vitro technique was used to determine the viability of the eggs of Taenia saginata. Inhibition of hatching has been observed following the exposure of T. saginata ova to lime, formalin-based chemicals, silver nitrate, osmium tetroxide and gluteraldehyde. Variable activity against Taenia was observed upon exposure of T. saginata ova to SX-1 and per-acetic acid. Both bis-biguanides and quaternary ammonium salts exhibit penetrative, ovicidal activity against T. saginata eggs. Lime treatment, SX-1, DF 955 and quaternary ammonium compound 739 all showed ovicidal activity to A. suum. There is preliminary evidence that the hatch-inhibition effect of lime and formaline in vitro is valid in vivo and that such treatments may offer a possible control measure for parasite ova in sewage sludge. Results of tests on the effects of MB 724, showed that this compound gave total lysis of T. saginata ova in water and inhibition of hatchability at 300 ppm in sludge liquor. (See also W88-00237) (Geiger-PTT)
W88-00260

EFFECT OF LIME TREATMENT OF SEWAGE SLUDGE ON THE HATCHING AND VIABILITY OF HUMAN BEEF TAPEWORM,
Welsh Water Authority, Powys.
J. E. P. Poole, and M. J. Mills.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 440-448, 4 tab, 12 ref.

Descriptors: *Parasites, *Eggs, *Sewage sludge, *Disinfection, *Lime, Sludge disposal, Land application, Chemical treatment, Hatching, Sludge, Land disposal, Hydrogen ion concentration.

The effect of lime treatment of sewage sludge on the hatching and viability of Taenia saginata and Taenia hydatigena ova was examined in vitro. In addition, T. hydatigena ova drawn from the same batch used for the in vitro trials were suspended for three days in water limed to pH 12, and fed by a tube, inserted into the esophagus, to three lambs. Control lambs were fed untreated ova in a saline suspension. After eight weeks the lambs were slaughtered and examined for cysts. Results of in vitro tests showed that exposure of T. saginata eggs to pH 11 and pH 12 liquor depressed hatching, and inhibition was complete after 24 hr and 3 hr, respectively. In vitro trials with T. hydatigena showed that suspension of ova in pH 11 sludge liquor had little effect until the 8-day and 11-day exposures when hatching was reduced to 33%. Results from in vivo tests showed that lime treatment of ova reduced the level of infection to 20% of the value obtained with the control ova. (See also W88-00237) (Geiger-PTT)
W88-00261

FACTORS THAT GOVERN THE SURVIVAL OF SELECTED PARASITES IN SEWAGE SLUDGES,
University of Manchester Inst. of Science and Technology (England).
R. J. Kiff, and R. Lewis-Jones.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 452-461, 3 fig, 18 ref.

Descriptors: *Parasites, *Sewage sludge, *Hydrogen ion concentration, *Temperature, *Organic acids, *Digested sludge, Eggs, Wastewater treatment, Disinfection, Chemical treatment, Hatching, Sludge.

The factors that govern the viability of parasite ova in sewage sludges were examined in laboratory tests. At all temperatures studied, acid pH inhibited the normal development of Ascaris eggs. Ascaris egg development was inhibited at 50, 55, and 60 degrees. Five minutes exposure to 55 degrees resulted in obvious damage to Monieza eggs. Similar results occurred at 60 degrees for two minutes. All three temperatures produced total inhibition of normal development in Fasciola eggs. The seeding of both primary and digested sludges with Ascaris eggs at room temperature resulted in complete inhibition of egg development. Both primary and digested sludge produced similar results. When held at a temperature of 45 degrees for 60 minutes, both primary and digested sludge had an adverse effect on the majority of Monieza eggs. Organic acids produced an almost complete inhibition of Ascaris egg development. Exposure to organic acids resulted in damage to Monieza eggs. After 19 days in organic acids, the majority of Fasciola eggs developed to a divided embryo at room temperature and to a miracidial stage at 27 degrees. (See also W88-00237) (Geiger-PTT)
W88-00262

IONISING RADIATION TO TREAT SLUDGE: ENERGY SOURCES AND FUTURE PROSPECTS,
Water Research Centre, Stevenage (England).
K. E. White.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 462-486, 6 fig, 31 ref, 2 append.

Descriptors: *Disinfection, *Sewage sludge, *Wastewater treatment, *Ionization, *Radiation, Sludge, Energy, Cost analysis, Irradiation, Design criteria, Cesium radioisotopes, Cobalt radioiso-

topes, Recycling, Wastewater facilities, Future planning.

The facilities available to supply ionizing radiation to disinfect sewage sludge and recent design and program developments in the field of ionizing radiation, particularly in the USA and Canada are reviewed. Radionuclide sources are mostly solid material, encapsulated in double containment devices prepared according to rigorous standards. The various sources of radiation that have been used and those whose potential has been determined are Co6O, Cs137, accelerators, and fuel elements. About 145 plants in the United States have been identified as sites where sludge may be recycled and where cost-effective irradiation technology might be employed for disinfection. Other countries using ionizing radiation for the treatment of sludge and effluents are Japan, Canada, Germany, Belgium, Switzerland, Holland, and the United Kingdom. Process costs are so dominated by site specific factors that a careful evaluation of the energy source and plant design options would be necessary before consideration is given to complete irradiation facilities available on the market. Electron treatment provides disinfection at ambient temperature, in a non-destructive way with respect to the components which may be used for recycling. Such use complements the energy conservation aspects of the process, and in the case of Cs137, the concept of combining two waste liabilities to produce a useful product for agriculture is an attractive social option. (See also W88-00237) (Geiger-PTT)
W88-00263

COST COMPARISON OF PREFABRICATED AND CONVENTIONAL DIGESTERS,
Water Research Centre, Stevenage (England).
W. K. Wolinski.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 488-499, 5 ref, 2 append.

Descriptors: *Cost analysis, *Sludge digestion, *Anaerobic digestion, *Wastewater facilities, *Comparison studies, Wastewater treatment, Digestion, Sludge thickening, Graphical analysis, Capital costs, Dewatering, Fabrication, Operating costs, Economic aspects, Graphical methods.

This study compares the cost of a conventional digestion plant, based on concrete tanks built in situ, with those of prefabricated packages currently available. Data are presented graphically for retention times of 15 days (high rate) and 30 days (conventional rate), with and without prethickening. Results show that the cost of digestion can be significantly reduced by using prefabricated plants. Further savings can be achieved by reducing retention time, although a plant of equal size operating at a lower retention time would require larger sludge handling facilities. The capital cost for 15-day retention would therefore be more than with 30-day retention. Prethickening of sludge does not always result in a net savings in digestion costs, but it does reduce transport costs. These general trends are valid for digestion plants up to 20,000 cu m. For concrete and prefabricated digesters, the additional operating costs for thickening is very small. The graphical results of the study may be used to estimate the cost of a digestion plant when costs are presented as a function of digester size. Results are applied to the calculation of plant costs for a co-settled, primary plus activated sludge 4.5% total solids. The savings to be achieved by using prefabricated digestion plants are large enough to warrant serious consideration by authorities. (See also W88-00237) (Geiger-PTT)
W88-00264

DIGESTERS - A LOOK AT THE REASONS FOR FOULING AND AN EFFECTIVE ANSWER TO THE CLEANING OUT PROBLEM,
Thames Water Authority (England). Eastern Div., D. C. Dupree.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 499-514, 6 fig, 1 tab, 3 ref, 2 append.

Descriptors: *Digestion, *Hydraulic equipment, *Design criteria, *Fouling, Anaerobic digestion, Wastewater treatment, Hydraulic machinery, Pumps.

The loss of effective digester volume (EDV) occurs through the deposition of inert sand and fibrous material in working digesters. Scum-horns are usually provided for drawing-off the rag layer in digesters. However, use of these devices requires very low flow velocities, and such methods are usually abandoned. The rate of fouling of a digester will depend on the efficiency of pretreatment, the energy put into mixing, the effectiveness of withdrawal facilities, and the rate of the digestion process. The economics of digester cleaning depends on site conditions and requirements. In searching for parameters on which to base a design for a digester cleaning system, the first consideration was the effective rate of removal of sediment. The second parameter was that the process should be conducted from outside the digester in a safe, acceptable and clean working environment. The third parameter was system reliability, and the fourth was simplicity and availability. Mechanical handling devices were excluded on the basis of access. Pumps can be utilized directly where the suction head is less than 25 feet. Air carriage depends on a high-velocity flow of air making particles airborne. Water carriage provides an ejector or jet pump to discharge the contents in one step. Design and operation of a prototype jet pump cleaning system are described. (See also W88-00237) (Geiger-PTT)
W88-00265

CALCULATION OF VOLATILE SOLIDS DESTRUCTION DURING SLUDGE DIGESTION,
Water Research Centre, Stevenage (England).
W. J. Fisher.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 514-529, 7 tab, 9 ref, 2 append.

Descriptors: *Volatile solids, *Sludge digestion, *Mathematical equations, *Performance evaluation, Anaerobic digestion, Digestion, Theoretical analysis, Mass balance, Wastewater treatment, Digested sludge.

The fraction of volatile solids destroyed (FVSD) during digestion of sewage sludge is often used as an indicator of the degree of stabilization or the efficiency of digester performance. For routine control, variations in FVSD should be considered. Another indicator of digester performance is gas yield. Some United States federal regulations for stabilized sludges require that the FVSD be known. Deviations for the FVSD value by the full mass-balance method and the approximate mass balance method are given along with the results of some calculations of FVSD for a full-scale anaerobic digester. Derivation of the constant-ash and Van Kleeck's equations are described. (See also W88-00237) (Geiger-PTT)
W88-00266

ACCEPTABLE ALTERNATIVE: LIME STABILISATION OF SEWAGE SLUDGE AND DISPOSAL TO AGRICULTURAL LAND,
North West Water Authority, Bootle (England).
For primary bibliographic entry see Field 5E.
W88-00267

LIME STABILISATION OF UNDIGESTED SEWAGE SLUDGE,
Thames Water Authority, London (England).
J. J. Quinn, and J. E. Hall.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 540-546, 3 fig, 1 tab, 7 ref.

Descriptors: *Sludge disposal, *Land disposal, *Sewage sludge, Lime, Liquid sludge, Waste disposal, Liquid wastes, Land application, Wastewater treatment, Parasites, Disinfection, Fertilizers, Nutrients, Nitrogen, Sludge conditioning, Hydrogen ion concentration.

Laboratory and pilot-scale experiments were conducted to identify operating parameters for lime addition to undigested sludge, and full-scale pilot trials to assess the effect of limed liquid undigested sludge applied to grassland. A linear relationship between sludge solids and lime required to achieve pH 12.0 was found. The intercept obtained at 1.3 g/l of lime corresponds to the lime required to bring the liquid phase of the sludge to pH 12.0. This relationship held good for the limited number of co-settled sludges examined during the study. Samples with an initial pH below 9.0 showed a rapid drop to pH 6.5 within two days due to bacterial activity. Up to 50% more lime was required to raise the sludge pH after storage for periods between 5 and 12 days. Up to 98% of all bacteria are destroyed at pH 9.5 and 10.0; this figure increases to 99.5% at pH 12.0. Plot trials showed that an application of 70 cu m/ha limed liquid undigested sludge had no effect on grass yields in an experiment where the response to fertilizer nitrogen was only 5 to 10 kilograms-dm/kilograms nitrogen. Until the uncertainty over the effect lime has on viable Taenia saginata ova is resolved, the value of limed liquid undigested sludge as a viable treatment process option cannot be reliably assessed. (See also W88-00237) (Geiger-PTT)
W88-00268

REVIEW OF SEWAGE SLUDGE TREATMENT AND DISPOSAL IN EUROPE,
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5E.
W88-00269

MUNICIPAL WASTEWATER IN AGRICULTURE.
For primary bibliographic entry see Field 3C.
W88-00270

ROLE OF THE MEXICAN STATE AND FEDERAL GOVERNMENTS IN THE PROMOTION AND COORDINATION OF WASTEWATER RENOVATION AND REUSE,
Ministry of Agriculture and Water Resources, Mexico City.
For primary bibliographic entry see Field 3C.
W88-00271

ROLE OF FEDERAL AND STATE AGENCIES TO STIMULATE, COORDINATE, AND FUND RESEARCH RELATED TO THE RENOVATION AND REUSE OF MUNICIPAL WASTEWATER IN THE UNITED STATES,
Bureau of Reclamation, Washington, DC. Office of Water Research.
R. S. Madancy.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 13-25, 1 fig, 6 tab, 4 ref.

Descriptors: *Wastewater renovation, *Recycling, *Water reuse, *Research priorities, *Municipal wastewater, Wastewater disposal, Wastewater management, Reclaimed water, Government supports, Political aspects, Interagency cooperation, Government finance.

The role of federal agencies in water reuse research are to establish needs and potential for reuse through market analysis, evaluate existing technology, identify and prioritize research needs, fund and coordinate research, disseminate research findings and transfer development technology to potential users. In 1977, the Office of Water Research and Technology (OWRT) of the U.S. initiated its Water Reuse Research and Development Program by conducting a comprehensive national analysis of reuse and potential throughout the U.S. This study indicated that a high potential for both municipal reuse and industrial recycling exists in the U.S. The OWRT also evaluated existing treatment technology for applicability in reuse systems. The role of state agencies in implementing an effective wastewater reuse research program includes determining wastewater reclamation research needs, assessing the status of world-wide wastewater reclamation research, establishing a list of high priority research areas for funding priority, and working

cooperatively with federal agencies involved in water reuse. Projects involving beneficial reuse of wastewaters that result in reduction of wastewater discharges and utilization of nutrients, organic materials or pollutants should merit funding support at least equally with single purpose pollution abatement projects. (See also W88-00270) (Geiger-PTT)
W88-00272

ADMINISTRATIVE ASPECTS FOR THE RENOVATION AND REUSE OF WASTEWATER,
Engineering and Water Quality Lab., Mexico City.
C. M. Mora.
IN: Municipal Wastewater in Agriculture, Academic Press, New York. 1981. p 27-41, 1 fig, 3 tab, 8 ref.

Descriptors: *Wastewater renovation, *Water reuse, *Economic aspects, *Planning, *Administrative decisions, *Mexico, Wastewater irrigation, Recycling, Municipal wastewater, Wastewater management, Research priorities, Project planning, Administration, Water reuse, Evaluation.

In Mexico and other parts of the world, the reuse of wastewater has several advantages and disadvantages. Among the disadvantages, there is a lack of specific regulations to control the reuse of wastewater. The clean water which is supplied to towns is usually subsidized, which makes the reuse of wastewater economically unattractive. Toxic substances in the wastewater make it undesirable for reuse. The most well known uses for renovated wastewater are in industry and agricultural irrigation. With appropriate treatment measures, the only domestic activities in which treated wastewater would not be desirable or justifiable to use would be in drinking and food preparation. In planning wastewater reuse on a large scale, a preliminary model of inquiry could be carried out. The objectives of this investigation and the activities involved to carry it out are outlined. It is possible to considerably extend the areas of application of wastewater in municipalities in the areas of construction, public buildings, city cleaning, and fire control. In industry, it is possible to apply renovated wastewater in practically all uses. (See also W88-00270) (Geiger-PTT)
W88-00273

WORLDWIDE ASPECTS OF MUNICIPAL WASTEWATER RECLAMATION AND REUSE,
American Water Works Association Research Foundation, Denver, CO.
For primary bibliographic entry see Field 3C.
W88-00274

REUSE OF MUNICIPAL WASTEWATER FOR INDUSTRIAL PURPOSES IN MEXICO CITY,
Disenos Hidraulicos y Technologia S.A.,Mexico City.
For primary bibliographic entry see Field 3C.
W88-00275

MUNICIPAL WASTEWATER REUSE FOR DENVER,
Culp/Wesner/Culp, Denver, CO.
For primary bibliographic entry see Field 3C.
W88-00276

PROGRAM FOR THE REUSE OF WASTEWATER IN MEXICO CITY,
Departmento del Distrito Federal, Mexico City. Construcion y Operacion Hidraulica.
For primary bibliographic entry see Field 3C.
W88-00277

OPERATION OF A PILOT MUNICIPAL WASTEWATER TREATMENT PLANT FOR AGRICULTURAL REUSE,
Ministry of Agriculture and Water Resources, Mexico City. Center for Research in Water Reuse.
For primary bibliographic entry see Field 3C.
W88-00278

LAND TREATMENT: A VIABLE SOLUTION FOR MANAGEMENT OF WASTEWATER IN THE METROPOLITAN AREA OF THE VALLEY OF MEXICO,
Eco-Ingenieria S.A., Mexico City.
For primary bibliographic entry see Field 3C.
W88-00279

FLUSHING MEADOWS PROJECTS - WASTEWATER RENOVATION BY HIGH RATE INFILTRATION FOR GROUNDWATER RECHARGE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3C.
W88-00280

AGRICULTURAL LAND IRRIGATION WITH WASTEWATER IN THE MEZQUITAL VALLEY,
Valley of Mexico Water Commission, Mexico City.
For primary bibliographic entry see Field 3C.
W88-00281

MICHIGAN STATE UNIVERSITY WATER QUALITY MANAGEMENT FACILITY - A LAKE-LAND SYSTEM TO RECYCLE MUNICIPAL WASTEWATER,
Michigan State Univ., East Lansing. Inst. of Water Research.
For primary bibliographic entry see Field 3C.
W88-00282

TREATMENT AND FINAL DISPOSAL OF MUNICIPAL WASTEWATER AND SLUDGE ON THE LAND: PRESENT PRACTICES,
Monterrey Univ. (Mexico). Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W88-00286

DESIGN FACTORS FOR THE RAPID INFILTRATION, OVERLAND FLOW, AND SLOW RATE IRRIGATION WASTEWATER LAND APPLICATION SYSTEMS,
Culp/Wesner/Culp, Cameron Park, CA.
For primary bibliographic entry see Field 3C.
W88-00287

COMPARATIVE COSTS OF LAND TREATMENT VERSUS CONVENTIONAL WASTEWATER TREATMENT,
Economic Research Service, University Park, PA.
For primary bibliographic entry see Field 3C.
W88-00288

MANUAL FOR WATER RENOVATION AND RECLAMATION.
National Inst. for Water Research, Pretoria (South Africa).
Second Edition, 1981. 330p.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Wastewater renovation, *Ozonation, *Chlorination, *Water treatment, *Cost analysis, *Filtration, Clarification, Water reuse, Activated sludge, South Africa, Reviews, Activated carbon, Literature review.

The aim of this manual is the dissemination of information useful to design engineers, researchers and organizations concerned with the reclamation of water from wastewater. The Manual is based mainly on extensive investigations by the national Institute for Water Research on the operation of the 4,500 cu m/day Stander water reclamation plant, Pretoria, on biofilter humus tank and activated sludge effluent, as well as on laboratory and pilot scale investigations. The various treatment processes, such as clarification, ammonia stripping, softening, quality equalization, stabilization, filtration, active carbon adsorption and regeneration, sludge handling, chlorination and ozonation, are discussed in detail. Where necessary, the work is supplemented by applicable theories and supporting literature. Cost aspects of water renovation, as well as organization and control of water reclamation plants, are discussed. (See W88-00315 thru W88-0029) (Author's abstract)
W88-00314

INTRODUCTION TO WATER RENOVATION AND RECLAMATION,
O. O. Hart.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 1-16, 1 fig, 4 tab, 15 ref.

Descriptors: *Wastewater renovation, *Wastewater treatment, *Water reuse, *Clarification, *Chlorination, *Filtration, *Cost analysis, *Chemical treatment, Activated carbon, Ozonation, Secondary wastewater treatment, Sludge drying, Process control, Chemical precipitation, Advanced wastewater treatment.

The demand on freshwater resources has led to indirect and direct reuse of municipal wastewater to an ever-increasing extent. Research on water reclamation in South Africa has continued primarily at the Stander plant. In designing a water reclamation plant, it was noted that the quality of the secondary effluent to be renovated affects both the selection of unit processes and the choice and dosage of chemicals. The consistency of the raw water quality determines the sophistication of control instruments needed to control process parameters. A quality equalization pond is indispensable for water reclamation from secondary effluents with a great diurnal variation in quality. Other processes required for water reclamation include lime treatment, clarification, ammonia stripping, recarbonation, sand filtration, chlorination, ozonation, active carbon adsorption, final treatment, sludge dewatering, and active carbon regeneration. The cost of wastewater treatment is a function of plant size, wastewater characteristics, and degree of renovation required. Active carbon adsorption is the most expensive unit process and quality equalization is the most economical unit process. When ammonia stripping is required, reclamation costs increase by approximately 7%. (See also W88-00314) (Geiger-PTT)
W88-00315

LIME CLARIFICATION,
M. Ronen.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 17-44, 13 fig, 7 tab, 16 ref.

Descriptors: *Wastewater renovation, *Clarification, *Lime, *Flocculation, *Coagulation, *Wastewater treatment, *Chemical treatment, Chemical precipitation, Separation techniques, Process control, Water reuse, Turbidity, Design criteria.

Lime treatment involves coagulation, flocculation, and phase separation, all of which may be carried out in the reactor-clarifier. At the Stander plant, the clarification system consists of a lime reactor, and an upflow clarifier. In designing a lime treatment system, the lime dosage required and the size of clarifier needed should be considered. Screening tests should be performed to determine the coagulant aids needed. The efficiency of the lime-treatment process may be assessed in the turbidity of the clarified effluent. At the Stander plant a performance objective of <4 nephelometric turbidity units in the clarified effluent was established. Lime treatment affects the removal of nutrients, ammonia, microorganisms, trace elements and organic matter and the production of sludge. The lime treatment system consists of a chemical subsystem, a clarifier subsystem, and a residuals removal subsystem. The treatment site and maintenance of the plant should be considered when the lime treatment process is operated as the first stage of a complete water reclamation system. The general design sequence for a lime treatment plant comprises constitution of the need for lime treatment, process planning, equipment design and calculation of mass balance. (See also W88-00314) (Geiger-PTT)
W88-00316

QUALITY EQUALIZATION,
B. M. Van Vliet.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 45-60, 9 fig, 2 tab, 11 ref.

Descriptors: *Wastewater renovation, *Stabilization ponds, *Wastewater treatment, *Design criteria, *Equalizing basins, *Equalizing reservoirs, *Balancing reservoirs, *Aerated lagoons, Aeration, Mathematical models, Effluents.

The quality variability of effluents is an important problem in the design and operation of water renovation and reclamation plants. The mechanisms responsible for the attenuation of quality variability are reduction of a particular constituent by precipitation, flocculation, stripping, or biochemical degradation and dispersion and volumetric mixing of water in the various reactors. In reactors three types of flow occur, namely plug flow, dispersed flow and completely mixed flow. The attenuation factors for each type of flow can be determined mathematically. In the Stander plant, an equalization pond was incorporated in the treatment process and the ammonia stripping tower. Mathematical models were tested for their ability to describe the experimental ammonia desorption performance of the equalization pond. Two models were chosen, one to describe conditions using subsurface stirring, the other to describe conditions using surface aeration. Ammonia desorption in the pond was nearly twice as effective during surface aeration than during subsurface stirring. Hardness accumulating in the pond originated mainly from the precipitates formed with the pond itself. The equalization pond helped to reduce the number of bacteria and viruses in the secondary effluent. Design considerations include process flow, type of secondary effluent, ammonia levels, and type of lime pretreatment used. (See also W88-00314) (Geiger-PTT)
W88-00317

AMMONIA STRIPPING,
L. R. J. Van Vuuren.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 61-76, 10 fig, 9 ref, 5 tab.

Descriptors: *Ammonia stripping, *Wastewater treatment, *Design, *Ammonia, *Nitrogen compounds, *Denitrification, *Aeration, *Pilot plants, South Africa, Biological wastewater treatment, Air circulation, Wastewater facilities.

Ammonia plays a key role in the selection and operational control of water renovation and reclamation processes. It is of economic importance that ammonia be reduced to low levels before the chlorination stage. Ammonia stripping can be achieved with stripping towers or a series of aerated lagoons. Ammonia stripping towers are of two main types: the counter-flow tower in which the water is distributed at the top and the total air flow enters the bottom of the tower, and the cross-flow tower in which air is introduced at the side walls. Tower performance depends on certain fixed parameters, operational conditions, process parameters, and environmental conditions. Based on results with pilot scale towers, coated Al strips were selected as packing modules in the Windhoek tower of South Africa. Scale build-up was noted on the wooden slats used as packing material in the Stander plant. In designing ammonia stripping towers consideration should be given to efficient air and water distribution, type of packing and total surface area required, air to water ratio, and hydraulic loading rate. Ready access to the stack for cleaning and descaling should also be available. (See also W88-00314) (Geiger-PTT)
W88-00318

SOFTENING AND RECARBONATION,
J. Van Leeuwen, and H. N. S. Wiechers.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 77-98, 4 fig, 1 tab, 8 ref.

Descriptors: *Carbon dioxide, *Lime, *Hardness, *Wastewater treatment, *Wastewater renovation, *Water softening, *Dissolved solids, *Chemical precipitation, Hydrogen ion concentration, Recarbonation, Calcium, Magnesium, Calcium carbonate, Magnesium hydroxide.

Since most wastewaters to be reclaimed are harder than what is desirable for domestic use, softening or the removal of Ca and Mg ions is required. Softening by lime precipitation of CaCO3 and Mg(OH)2 usually increases pH and necessitates the process of recarbonation. In this unit process, CO2 is added to decrease the pH to an acceptable level. Modified Caldwell-Lawrence (MCL) diagrams are used to calculate the acidity or alkalinity that will result when the temperature, total dissolved solids, and Ca hardness are known. The MCL diagrams may also be used in selecting recarbonation parameters. Higher temperatures decrease the solubility of both Ca and Mg and are desirable during softening. Softening involves the use of dosing equipment for the chemicals required, reactors for the softening reaction, settlers to remove insoluble material, pumps and pipelines to draw off sludge from the settler, and proper storage vessels if bulk CO2 is to be stored on site for the process. (See also W88-00314) (Geiger-PTT)
W88-00319

FILTRATION,
L. R. J. Van Vuuren.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 99-112, 2 fig, 5 tab, 8 ref.

Descriptors: *Filtration, *Wastewater treatment, *Wastewater renovation, *Sand filters, *Gravity filters, *Biological wastewater treatment, *Sedimentation, *Flocculation, Disinfection, Adsorption, Effluents, Secondary wastewater, Process control.

In water reclamation, complete disinfection is secured through effective turbidity removal by filtration, followed by chlorination. In South Africa, the reclamation of potable water from secondary and algal maturation pond effluents has been satisfactorily performed using conventional rapid gravity filters. Filtration involves the mechanisms of straining, sedimentation, flocculation, adsorption, and biological activity. In the field of water renovation and reclamation, the slow sand filter, rapid gravity filter and mixed media filter have each been utilized. Rapid gravity or pressure filters allow the sand to be cleaned in situ by backwashing. Dual media filters usually replace part of the sand with anthracite, an improvement which results in reduced rates of head loss. With the advent of multi-media beds and increasing experience with polyelectrolytes, it has been possible to integrate coagulation, flocculation and filtration into a single process. Process control of filtration involves maintaining a constant influent and effluent flow rate. In declining rate filtration, no flow controller is needed. Newer techniques in filtration include upflow, biflow, and radial flow. Special process parameters and equipment considerations must be taken into account where the filtration process is used in water reclamation in conjunction with disinfection control. (See also W88-00314) (Geiger-PTT)
W88-00320

CHLORINATION,
J. Van Leeuwen.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 113-128, 4 fig, 19 ref.

Descriptors: *Chlorination, *Wastewater renovation, *Wastewater treatment, *Disinfection, *Ammonia, *Cost analysis, *Process control, *Water reuse, Dissolved solids, Hardness, Water quality, Filtration, Chlorine.

Chlorination has been proven to be an efficient method of disinfection in water reclamation. The proper design of a chlorination unit process and associated control equipment is essential for proper disinfection. Operating the actual breakpoint chlorination process at a pH of 7 reduces treatment costs and improves water quality. The effects of chlorination on stabilization and ammonia removal should be considered in plant design. Use of chlorination instead of recarbonation for stabilization before sand filtration creates permanent hardness and increases the concentration of total dissolved solids. Breakpoint chlorination for the removal of all ammonia instead of partial ammonia stripping combined with breakpoint chlorination leads to the formation of more chlorides than the latter method. However, the combined effect of both these disadvantages is not important for water used for domestic purposes. The cost savings achieved at the Stander plant with an average ammonia concentration of 3.1 mg/cu amounted to about 0.029/cu m or a cost benefit of 10%. (See also W88-00314) (Geiger-PTT)
W88-00321

OZONATION,
J. Van Leeuwen.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 129-150, 4 fig, 43 ref.

Descriptors: *Ozonation, *Ozone, *Disinfection, *Wastewater renovation, *Reclaimed water, *Activated carbon, *Wastewater treatment, *Cost analysis, Process control, Turbidity, Chlorination, Ammonia, Hardness, Chemical treatment.

Ozonation serves to oxidize organic and inorganic compounds to less harmful or more easily removable substances. It allows easier removal of biodegradable forms by biological active carbon and completes the disinfection requirements. Ozonation is affected by the water quality parameters of turbidity, ammonia, nitrogen compounds, organic compounds alkalinity and hardness. Mass transfer coefficients for water-ozone systems are presented. Packed tray columns or spray towers are used to effect a long retention time of the gas phase during ozonation. The most suitable packing materials from experiences at the Stander plant include 50 mm Pall rings in stainless steel, 50 mm Mini cascade rings in polypropylene, 38 or 50 mm porcelain Raschig rings, and 38 or 50 mm porcelain Intalox saddles. Ozonation had little affect on the rate of chemical oxygen demand and total organic carbon removal after six months of use at the Stander plant. A chlorination treatment is needed to supplement ozonation as ozone has no residual. A pre-chlorination step is preferred when lime clarification is replaced by ferric chloride clarification followed by ozonation. Construction material for the ozone reactor may be steel when pH < 8.5. When the ozone concentration is high, suitable coatings must be used. The use of ozonation in water reclamation can effect a marginal reduction in the total cost of producing the final water by reducing the cost of active carbon treatment. (See also W88-00314) (Geiger-PTT)
W88-00322

ACTIVE CARBON ADSORPTION,
B. M. Van Vliet.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 151-176, 4 fig, 3 tab, 27 ref.

Descriptors: *Carbon, *Activated carbon, *Adsorption, *Wastewater treatment, *Wastewater renovation, *Process control, *Design criteria, *Adsorbents, Organic compounds, Heavy metals, Models, Reclaimed water, Separation techniques.

Activated carbon readily adsorbs many classes of compounds and is widely used in water renovation and reclamation for the adsorption of dissolved organic compounds and heavy metals. Adsorption is affected by the magnitude and nature of the surface area of the adsorbent, pore size distribution of the adsorbent, nature and concentration of the solute, temperature and pH of the solution and contacting system. Adsorption thermodynamics, equilibria, and kinetics are discussed. The advantages of the granular carbon system and the powdered carbon systems are compared. For granular carbon contacting systems, the modes of operation available are countercurrent moving bed, expanded-bed upflow, and fixed-bed downflow. Carbon characteristics important in selecting active carbon are iodine number, apparent density, particle size

distribution, and abrasion resistance. To complete the process design, contact time and carbon exhaustion rate must be determined. There are three basic categories used to define the design approaches used in developing final process parameters: the simplistic method, pilot column data based methods, and mass transfer theory methods. An overview of the active carbon adsorption system at the Stander plant is given along with process and equipment design criteria. Inter-adsorber and intra-adsorber operations are described and backwashing and adsorber regeneration strategies are discussed. (See also W88-00314) (Geiger-PTT)
W88-00323

SLUDGE DEWATERING,
M. Ronen.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 177-196, 9 fig, 5 tab, 10 ref.

Descriptors: *Cost analysis, *Sludge drying, *Dewatering, *Wastewater treatment, *Design criteria, *Vacuum drying, *Centrifugation, *Wastewater renovation, Lime, Chemical sludge, Operating costs, Capital costs, Process control, Separation techniques.

Lime sludges which accumulate during the clarification process of wastewater renovation operations generally contain large volumes of water. Lime sludges can be dewatered by drying on sand beds or by mechanical dewatering processes such as vacuum filtration, press filtration, and centrifugation. At the Stander plant, the solid bowl centrifuge is used for sludge dewatering. Centrifugation efficiency will be affected by bowl speed and configuration, pool volume, scroll differential speed, hydraulic flow rate of feed sludge, solids load, polymer dosage, pH and physicochemical properties of the sludge. The sigma or beta concepts may be applied to similar centrifuges to elevate performance based on design. The effects of some operational variables on centrifugal dewatering were evaluated at the Stander plant. A mathematical model describing the centrifugal dewatering of lime sludges is presented. Design of centrifuges should be based on full- and pilot-scale experience with prototypes, using the same kind of sludge. The capital costs and operational costs which should be considered in an economic evaluation of centrifugal dewatering and disposal of lime sludges are listed. (See also W88-00314) (Geiger-PTT)
W88-00324

CARBON REGENERATION,
B. M. Van Vliet.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 197-212, 5 fig, 3 tab, 35 ref.

Descriptors: *Activated carbon, *Regeneration, *Wastewater treatment, *Wastewater renovation, *Design criteria, *Process control, *Carbon, *Pilot plants, Separation techniques, Dewatering, Reclaimed water, Energy.

To make granular active carbon treatment economically feasible for water reclamation purposes, spent carbon must be regenerated and made available for repeated cycles of application. Spent granular active carbon can be regenerated thermally, chemically, or extractively. A multi-hearth furnace was erected at the Stander plant in 1975 for the thermal regeneration of spent carbon. Quality studies showed that, in general, carbon obtained from the second regeneration cycle was of somewhat better quality than that obtained from the first cycle. Process water quality (in terms of chemical oxygen demand) was substantially the same using either regenerated or virgin carbon. The amount of liquified petroleum gas and electrical energy used for carbon regeneration were reduced for the second cycle. For process design purposes, the carbon exhaustion rate and the carbon loading rate must be known for sizing of the furnace. Methods for calculating the thermal and electrical energy requirements for carbon regeneration are given. The inner lining of the furnace should be of high quality material and rated for continuous operation at 1,050 C. The rabble arms should be of 310 stainless steel. Other equipment design considerations which are discussed include inspection doors, steam supply points, dewatering systems, exit chute, quench tank, combustion equipment, after burner, scrubber, stack, carbon storage tanks and control equipment. (See also W88-00314) (Geiger-PTT)
W88-00325

FINAL TREATMENT,
J. Van Leeuwen.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 213-226, 2 fig, 1 tab, 9 ref.

Descriptors: *Chlorination, *Scaling, *Corrosion, *Hydrogen ion concentration, *Calcium carbonate, *Wastewater renovation, *Pipes, *Slime, Disinfection, Fouling, Acidity, Hardness, Water distribution, Chlorine, Wastewater treatment, Pipelines.

Before renovated wastewater is allowed to enter distribution systems, it should be disinfected to prevent slime growth, corrosion of pipes and obnoxious tastes, colors and odors. Coatings and claddings can prevent direct contact of water and metal piping. CaCO3 is a salt found in most natural waters which is useful in forming a self-healing or natural protective coating. Excessive coatings can cause scaling. Scaling can sometimes be controlled by water pH or sequestrants and inhibitors. Chlorine dosing is practiced to provide a residual of disinfectant to inhibit microorganism growth in the distribution system. The stability of a water with respect to scale formation is sometimes calculated using the Ryznar of Lagelier indices. Examples are given of water stabilization strategies before sand filtration. Control of the carbonic system is accomplished by dosing chemicals which always affect at least two of the following parameters: calcium hardness, acidity, and pH. Reliable pH electrodes are essential for process control. (See also W88-00314) (Geiger-PTT)
W88-00326

OPERATIONAL GUIDELINES,
O. O. Hart.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 227-264, 3 fig, 9 tab, 7 ref.

Descriptors: *Process control, *Wastewater renovation, *Monitoring, *Wastewater treatment, *Management planning, *Training, *Wastewater management, *Operating policies, Automation, Chemical treatment, Design criteria, Wastewater facilities, Pilot plants.

The primary goal of a water reclamation plant is to remove all pathogens and toxic substances. To achieve this, performance objectives must be determined for each unit process. Proven key parameters for each process should be controlled to within narrow limits by hourly monitoring. Automated control loops are indispensible for critical operation, but should be inspected manually to prevent parameters from becoming out of control. The operators should adhere closely to sampling schedules and keep meticulous records. The superintendent should carefully scrutinize analytical results. The whole system must feature a strategy whereby substandard water can never reach the distribution system. Two such barriers are incorporated at the Stander plant for each contaminant. A comprehensive plant control manual as well as a complete maintenance manual and properly trained maintenance and operational personnel are essential for plant control. (See also W88-00314) (Geiger-PTT)
W88-00327

HEALTH ASPECTS,
W. H. J. Hattingh, E. M. Nupen, J. F. J. Van Rensburg, and W. S. G. Morgan.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 265-290, 11 tab, 76 ref.

Descriptors: *Water quality, *Wastewater treatment, *Wastewater renovation, *Potable water, *Drinking water, *Water quality standards, *Public health, *Reclaimed water, Chemical properties, Performance evaluation, Water analysis, Toxicity, Microbiological studies.

Chemical and microbiological evaluations were made of the quality of the water reclaimed by the Stander plant over ten years of operation. Results of the microbiological studies show that a standard of no coliform bacteria per 100 cu m, a total plate count of <100 per cu m and no detectable enteric viruses in 10 to 100 cu dm is an adequate criterion for the routine testing of reclaimed water. A water which conforms to these specifications should have no adverse microbiological effects on human health. Results of chemical analyses show that the reclaimed water is of high quality and conforms to all known potable water standards. In bioassays, this water had no deleterious effect on rats or fish and displayed lower mutagenicity, toxicity and transformation activity (carcinogenicity) than drinking waters obtained by conventional purification of surface water. It was concluded that the use of reclaimed water for drinking purposes should not present a health hazard. (See also W88-00314) (Geiger-PTT)
W88-00328

WATER RECLAMATION USING METAL IONS AS PRIMARY COAGULANTS,
L. R. J. Van Vuuren, J. Prinsloo, and J. Maree.
IN: Manual for Water Renovation and Reclamation, Second edition. 1981. p 291-304, 5 fig, 6 tab, 14 ref.

Descriptors: *Coagulation, *Clarification, *Iron compounds, *Aluminum, *Alum, *Lime, *Wastewater renovation, *Cost analysis, Chemical coagulation, Precipitation, Separation techniques, Wastewater treatment, Pilot plants, Comparison studies.

Since 1979, the Stander plant has been operating using ferric chloride as principal coagulant for the reclamation of water from activated sludge effluent, while the Windhoek plant has used alum as the principal coagulant. Aluminum and iron coagulation avoid the large sludge build-up common with lime coagulation and are also less expensive than high lime treatment (HLT). A comparison was made of HLT and metal coagulants during full-scale operations at the Stander plant. Use of metal coagulants as substitutes for HLT allowed external recycling of metal hydroxide sludges. All three clarification techniques gave satisfactory results upon microbiological and chemical quality analyses. Results of cost analyses based on capital, maintenance, operational, chemical and energy costs showed that HLT was the most expensive clarification process, followed by the ferric chloride then alum treatment. However, with respect to design considerations, when the effluent to be renovated contains high concentrations of ammonia, lime treatment is the most suitable coagulant. In choosing equipment, it should be noted that ferric chloride is highly corrosive. The most suitable pumps for use with ferric chloride solutions are of polymeric materials and piping should be of polymeric tubing, PVC, polyethylene or bitumen- or epoxy-coated steel. Process control is needed for proper dosing of coagulants. (See also W88-00314) (Geiger-PTT)
W88-00329

WASTEWATER TREATMENT,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
IN: Environmental Pollution and Control, 2nd edition. Butterworth, Boston, MA. 1983. p 83-111, 15 fig, 3 tab.

Descriptors: *Wastewater treatment, *Activated sludge process, Septic tanks, Advanced wastewater treatment, Biological wastewater treatment, Chlorination, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment, Trickling filters, Aeration, Filtration, Activated carbon, Adsorption, Nitrogen removal, Nitrification.

Wastewater discharges in a sanitary sewer system are comprised of domestic wastes, industrial wastes, and infiltration. Many treatment options are available. A widely used on-site method is the septic tank with tile disposal field. Central wastewater treatment consists of primary treatment (solids removal), secondary treatment (removal of oxygen demanding matter), and tertiary treatment (removal of other undesirable substances such as nutrients). Primary treatment uses screens to remove floating material, comminutors (grinders) to reduce the size of the material going through the screen, and grit/sand removal in a grit chamber and settling tanks. Most secondary treatment methods use microbial action to reduce BOD. Trickling filters or the many modifications of the activated sludge system are available. Tertiary treatment may use pebble filters, microstrainers, oxidation ponds, activated carbon adsorption, nitrification, chemical phosphorus removal, or land treatment, depending on the effluent and treatment goals. (See also W88-00314) (Cassar-PTT)
W88-00334

CHEMISTRY IN WATER REUSE: VOLUME 2.
Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. 647 p.

Descriptors: *Water reuse, *Wastewater treatment, *Water treatment, *Pollutant identification, Organic compounds, Chlorine compounds, Trace levels, Resins, Toxicity, Membrane processes, Activated carbon, Adsorption, Ozonation, Aquatic plants, Disinfection, Irradiation, Viruses, Parasites, Sludge, Water analysis, Fate of pollutants, Mutagens, Heavy metals, Industrial wastewater, Water pollution sources, Digestion.

Papers on the chemistry of water reuse and recycling concern analytical methods and characterization, concentration of organics for toxicity testing, activated carbon theory and application, water and wastewater treatment techniques, and control of viruses and parasites. Most of the work on analytical techniques involves organic compounds, particularly chlorinated products. Methods are also described for determination in wastewater of hydrazine and related compounds. Trace organics in samples are concentrated by resins, the Parfait distillation column, and membrane processes. Among the specific applications of activated carbon treatment are benzene, polychlorinated biphenyls, and electroplating wastes. Wastewater treatment techniques with water reuse under consideration are given for priority pollutants, polyaromatics, ammonia, and phenolic compounds. Some of the wastewater treatment methods are powdered activated carbon with activated sludge (the PACT process), ozonation, an anaerobic activated carbon filter, removal with vascular aquatic plants, ferrate ion disinfection and coagulation, and irradiation. The electrokinetics of viruses by clays is described. Parasite inactivation in domestic sludges is accomplished by anaerobic digestion, aerobic digestion, ammonia treatment, lime treatment, and ultrasonics. (See W88-00435 thru W88-00462) (Cassar-PTT)
W88-00434

CHARACTERIZATION OF ORGANIC MATERIALS AT WATER FACTORY 21,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-00437

SELECTIVE ADSORPTION OF ORGANIC HOMOLOGS ONTO ACTIVATED CARBON FROM DILUTE AQUEOUS SOLUTIONS-SOLOVOPHOBIC INTERACTION APPROACH: DEVELOPMENT AND TEST THEORY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W88-00445

REMOVAL OF CD(II) FROM PLATING WASTE WATER BY AN ACTIVATED CARBON PROCESS,
Delaware Univ., Newark. Dept. of Civil Engineering.
C. P. Huang, and E. H. Smith.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 355-400, 21 fig, 5 tab, 66 ref. Contract No. R805835010.

Descriptors: *Wastewater treatment, *Metal-finishing wastes, *Cadmium, *Activated carbon, *Adsorption, Metals, Heavy metals, Industrial wastewater, Cyanide, Fluoroborates, Kinetics, Hydrogen ion concentration, Temperature effects, Nuchar.

Commercially available activated carbons, particularly the powdered materials Nuchar S-A and Nuchar S-N, adsorbed appreciable amounts of Cd(++) from electroplating wastewaters. In both the fluoroborate and cyanide systems the maximum adsorption level was reached within 10 min. This rapid rate of removal was unaffected by variations in pH, ionic strength, carbon dose/Cd(++) concentration, temperature, and mixing rate. The extent of Cd(++) removal depended on carbon type, carbon dose/Cd(++) concentration, pH, wastewater composition, and ionic strength. For the same carbon dose, the adsorption density increased for increasing Cd(++) concentration in solution (typically about 11 ppm). However, the percent of Cd removed decreased for higher initial concentrations of adsorbate, particularly at acidic pH. At pH values >8 this effect was not as noticeable because of precipitation (in the fluoroborate bath) or cadmium cyanide complex formation (cyanide system). For both types of wastewater the adsorption density approached its maximum level in the neutral pH range, eliminating the need for pH adjustment. Cadmium adsorption was higher from the fluoroborate bath than from the cyanide wastewater. This problem, a result of the competition between cyanide and cadmium for carbon sites, can be overcome by reducing the initial cyanide concentration in the wastewater or increasing the carbon dose. Cadmium adsorption increased with decreasing ionic strength of the solution. (See also W88-00434) (Cassar-PTT)
W88-00451

REMOVAL OF PRIORITY POLLUTANTS WITH A COMBINED POWDERED ACTIVATED CARBON-ACTIVATED SLUDGE PROCESS,
Du Pont de Nemours (E.I.) and Co., Deepwater, NJ. Chambers Works.
D. G. Hutton.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 403-428, 22 fig, 10 tab.

Descriptors: *Wastewater treatment, *Chemical wastewater, *Biological wastewater treatment, *Organic compounds, *Activated carbon, Du Pont Company, Metals, Cyanide, PACT process, Heavy metals, Industrial wastewater, Chemical precipitation, Lime, Primary wastewater treatment.

The Du Pont PACT process (aerated biological treatment with added powdered activated carbon) effectively removed priority pollutants from the wastewater in the Chambers Works 40 mgd wastewater treatment plant. In 1978 average removal of organics was 81%, measured as dissolved organic carbon. BOD removal averaged 95%, color removal, 64%. Several compounds for which removal was less than 80% were dichlorobenzenes, trichlorphenol, and dinitrotoluenes. Metals and cyanide were removed both in the primary treatment (lime precipitation with sludge removal) and in the biological phase as follows (all values are parts/billion): antimony, 30 to 10; arsenic, 30 to 21; beryllium, negligible removal; cadmium, negligible removal; chromium, 370 to 10; copper, 206 to 70; cyanide, 360 to 181; lead, 406 to 54; mercury, 0.6 to 0.01; nickel, 231 to 50; selenium, negligible removal; and zinc, 1500 to 360. Most of the metals removal was accomplished in the primary stage of treatment. (See also W88-00434) (Cassar-PTT)
W88-00452

STUDY OF UV-OZONE REACTIONS WITH ORGANIC COMPOUNDS IN WATER,
Battelle Columbus Labs., OH.
M. K. Lee.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 445-464, 7 fig, 23 ref. Contract No. DAMD 17-76-C-6063.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Ozonation, *Organic compounds, *Ultraviolet radiation, Kinetics, Chemical reactions, Oxidation, Model studies.

Ozone chemistry in the aqueous phase with ultraviolet (UV) radiation was reviewed and an overall reaction scheme was proposed. It was postulated that ozone first dissolves in liquid and reacts with water under UV radiation to produce hydroxyl radicals. These radicals, which are the products of ozone decomposition, were suggested to be largely responsible for the oxidation of the organic compounds in water. The direct oxidation of organics by ozone is not believed to be the predominant reaction under UV radiation. The radical recombination reaction can become significant during the last stage of oxidation when the organic concentration level becomes very low. Analytical expressions were derived to describe the overall rate of contaminant destruction during the initial period and the tail end of reaction. The initial period is characterized by the high level of contaminant concentration while at the tail end of the reaction the contaminant concentration approaches zero. The analysis showed that during the initial period the contaminant destruction rate is directly proportional to the ozone partial pressure and does not depend on the contaminant concentration. In the final stage of the reaction, the rate was shown to be strongly dependent on the contaminant concentration. Based on the analytical expressions for the above extreme cases, a simple rate equation was proposed to describe the reaction in the intermediate range between the initial period and the final stage. The rate during this period could be described by a simple function of superficial gas velocity, ozone partial pressure and the contaminant concentration. (Author's abstract)
W88-00454

DIFFUSED-AIR STRIPPING OF AMMONIA IN ADVANCED WASTEWATER TREATMENT,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
E. Shpirt.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 497-508, 5 fig, 1 tab, 18 ref.

Descriptors: *Wastewater treatment, *Ammonia, *Nitrogen removal, *Aeration, Mathematical models, Model studies.

Ammonia removal from wastewater by diffused aeration was performed in laboratory tests. A mathematical model was developed to optimize the design of the system. Equations are given for determining air requirements and retention time. (See also W88-00434) (Cassar-PTT)
W88-00456

TREATMENT OF PHENOL AND SUBSTITUTED PHENOLS WITH AN ANAEROBIC ACTIVATED CARBON FILTER,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
M. T. Suidan, W. H. Cross, K. A. Kahn, and M. Fong.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 509-520, 7 fig, 17 ref. Contract No. EF-77-G-01-2756.

Descriptors: *Wastewater treatment, *Organic compounds, *Activated carbon, *Anaerobic digestion, Biological wastewater treatment, Phenol, Catechol, Cresol, Industrial wastewater.

An anaerobic activated carbon filter treatment system was used to degrade phenolic compounds in a simulated wastewater. Phenol at a concentration of 200 mg/L did not produce methane gas in the reactor until day 135, when the effluent phenol level dropped from 100 mg/L to <5 mg/L. When the phenol feed was increased to 400 mg/L con-

centration, COD removal efficiencies reached 93% at steady-state conditions. In the three-column phenol apparatus nearly all methane production occurred in the first column. Catechol was treated in a four-column system. Results were similar to the results from phenol treatment. Three phases were observed in treatment of both compounds: initial adsorption and biodegradation of the activated carbon, bioregeneration of the carbon, and steady-state performance. A solution of 256 mg/L o-cresol produced very little methane over the 420-day study. However, coacclimation with 100 mg/L glucose allowed the system to start degrading o-cresol. (See also W88-00434) (Cassar-PTT)
W88-00457

TERTIARY WASTEWATER TREATMENT BY THE APPLICATION OF VASCULAR AQUATIC PLANTS,
Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
S. Tridech, A. J. Englande, M. J. Hebert, and R. F. Wilkinson.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 521-539, 9 tab, 16 ref.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Aquatic plants, *Metals, *Nutrients, Tertiary wastewater treatment, Biological wastewater treatment, Bulrush, Water hyacinth, Metals, Heavy metals, Nitrogen, Coliforms, Phosphates, Phenol, Organic compounds.

A variety of vascular aquatic plants were exposed to secondary wastewater effluent to compare the relative efficiency of organic, nutrient, and trace contaminant removals. Analysis of plants in a field survey showed that most aquatic plants had very high concentration factors for chemicals. Concentration factors were especially high for selenium, phenol, and mercury (48,980 in coontail; 65,000 in elodea,; and 20,330 in water bonnet in micrograms/g dry weight/micrograms/mL water, respectively). Bulrush (Scirpus spp.) and water hyacinths were selected by batch screening for continuous-flow studies. During a nonrecirculation run with 15-day detention the water hyacinth system removed 95% of BOD, 80% of total organic carbon, 85% of nitrogen, and 65% of phosphate. Bulrush removed 91% of cadmium, 93% of mercury, and 85% of selenium. Both plants removed >96% of phenol and >95% of polychlorinated biphenyls. Arsenic and boron removals were low, 41-56% and 36%, respectively. Even with poor quality of the secondary effluent feedwater, the water hyacinth system showed 95% and 80% removal of BOD and total organic carbon, respectively, with an average effluent concentration of 2.3 and 5.1 mg/L, respectively. Bulrush was less effective in removing organics and nutrients; however, it showed higher removals of other trace contaminants including cadmium, mercury, and selenium. Fecal coliforms reduction was >95%. In a 1:1 recirculation, 7.5-day retention continuous-flow study results were similar to the nonrecirculation study above. It was concluded that recirculation aided pollutant removal. (See also W88-00434) (Cassar-PTT)
W88-00458

TREATMENT OF DOMESTIC WASTEWATER FOR REUSE WITH IRON(VI) FERRATE,
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
T. D. Waite.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 541-560, 10 fig, 2 tab, 19 ref.

Descriptors: *Wastewater treatment, *Disinfection, *Coagulation, *Iron compounds, Ferrates, Oxidation, Phosphates, Coliforms, Bacteria, Bromides, Chlorides.

Ferrate ion, FeO4(–), has the potential to serve as both a disinfectant and coagulant for treatment of wastewater for reuse. It remains a powerful oxidizing agent through the entire pH range. Potassium ferrate decomposes in water, generating hydroxide ion and molecular oxygen. Phosphates tend to stabilize ferrate solutions; nitrate has little effect on ferrate stability. Ferrate is an effective biocide for suspended bacterial culture. Good disinfection occurs in relatively clean water systems at 0.00001 molar ferrate. Viruses are also sensitive to ferrate. Coagulation studies are reported. The optimum dose is about 5 mg/L Fe. The presence of phosphate in a system coagulated with ferrate has a positive effect on the destabilization process. The BOD and total organic carbon removals in secondary effluent when coagulated with 10 mg/L ferrate are 96% and 33%, respectively. Ferrate does not oxidize chloride ion, but it is capable of oxidizing bromide under acid conditions. However, appreciable bromide oxidation is not expected to occur under the conditions prevalent in wastewater treatment. (See also W88-00434) (Cassar-PTT)
W88-00459

IRRADIATION FOR THE SAFE REUSE OF WATER AND WASTEWATER,
Hittman Associates, Inc., Columbia, MD.
D. D. Woodbridge.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 561-592, 21 fig, 3 tab, 53 ref. Contract No. DAAK-01-71-C-0296.

Descriptors: *Wastewater treatment, *Water treatment, *Irradiation, *Disinfection, Radiation, Radioactive isotopes, Cesium isotopes, Cobalt radioisotopes, Radioisotopes, Organic compounds, Chemical wastewater, Chlorine, Chlorine compounds, Ozone, Oxygenation, Phenolic compounds, Surfactants, Cyanide, Trinitrophenol, Benzopyrene, Aromatic compounds, Benzoquinone, Coliforms, Bacteria, Viruses.

Irradiation from Cs137 or Co60 can be an effective part of treating water or wastewater for reuse. It destroys carcinogenic and other toxic agents in wastewater directly or by secondary and tertiary effects. Some of the undesirable substances which have been destroyed or reduced in concentration by irradiation (often with synergists) include chlorine and chlorinated compounds, phenols, surfactants, cyanide, trinitrophenol, benzo(a)pyrene, and p-benzoquinone. Irradiation has also been effective in killing fecal coliforms, Staphylococcus aureus, and viruses, usually with one or more of the following: heat, ozone, oxygen, iodine, and chlorine. Data indicate that a two- or three-step process of irradiation with synergistic agents added between steps would further increase the rate of treatment. (See also W88-00434) (Cassar-PTT)
W88-00460

INTERPRETATION OF THE ADSORPTION OF VIRUSES BY CLAYS FROM THEIR ELECTROKINETIC PROPERTIES,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5F.
W88-00461

INACTIVATION OF PARASITE-CONTAMINATED DOMESTIC WASTEWATER SLUDGES,
Lubbock Christian Coll., TX. Inst. of Water Research.
D. B. Leftwich, R. S. Reimers, and A. J. Englande.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 613-634, 8 fig, 9 tab, 32 ref.

Descriptors: *Sludge digestion, *Parasites, Ammonia, Ultrasonics, Lime, Aerobic digestion, Anaerobic digestion, Ascaris, Toxocara, Eggs.

The results of laboratory studies on parasite inactivation by aerobic digestion, anaerobic digestion, lime stabilization, ammonia treatment, and ultrasonication indicated the following: (1) Aerobic digestion inactivated parasite eggs at temperatures of 55 C or greater within two hours, and at 45 C within two days. (2) Anaerobic digestion inactivated Ascaris and Toxocara eggs at temperatures greater than 45 C, but only retarded egg development at temperatures less than 45 C. (3) Lime stabilization produced noticeable reduction in viable Ascaris eggs (>80%) within one day for primary 28 C-aerobically digested, and 35 C-aerobically digested sludges under aerobic conditions at ambient temperatures with dosages of equal to or greater than 1000 mg lime/g suspended solids. While under anaerobic conditions at ambient temperatures, there was about 90% reduction of viable Ascaris eggs in 28 C-aerobically digested sludge within four days at a dosage of only 100 mg lime/g suspended solids. (4) The results of the ammonification studies were inconclusive. In aerobically digested sludges, the viable Ascaris eggs were reduced 95% within five days even in the control (no ammonia added). In the anaerobically digested sludges no reduction in viability was observed at any dosage of ammonia up to 5000 mg ammonium sulfate/g suspended solids. (5) Ultrasonification was effective in destroying Toxocara eggs at 49 kHz and 26 W with a 9-min exposure and at 64 kHz and 74 W with a 6-min exposure, but was not effective in destroying Ascaris eggs under the same conditions. (See also W88-00434) (Author's abstract)
W88-00462

MATHEMATICAL MODELS AND OPTIMIZATION TECHNIQUES FOR USE IN ANALYSIS AND DESIGN OF WASTEWATER TREATMENT SYSTEMS,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
C. C. Tang, E. D. Brill, and J. T. Pfeffer.
WRC Research Report No. 194, November 1984. 257 p, 40 fig, 45 tab, 131 ref, 9 app.

Descriptors: *Wastewater treatment, *Model studies, Secondary wastewater treatment, Mathematical models, Optimization, Sludge, Activated sludge process, Sedimentation, Sludge thickening, Anaerobic digestion, Digestion, Filtration, Vacuum filtration, Process control.

A mathematical framework is developed for use in the design of a secondary wastewater treatment system. Mathematical models predicting the performance of various unit processes are used to construct a comprehensive system model. Three efficient optimization approaches to generate cost effective system designs are studied. The first approach transcribes the comprehensive system model into a nonlinear program that includes 64 variables and 58 constraints. A generalized reduced gradient algorithm is applied to solve this model. The second approach uses an existing algorithm for solving generalized geometric programs. Partitioning of model variables into two sets is necessary. A number of geometric programming subproblems resulting from the partitioning are solved. The third approach decomposes the wastewater system into a liquid and a sludge subsystem. The liquid subsystem is optimally designed, while the sludge subsystem design includes embedded optimization steps. The overall optimal design is obtained from coordination between the two subsystem designs. The comprehensive system model can be used as a tool for the analysis of process performance. Important insights about process design, modeling, and integration can be gained by exercising the model. Potentially fruitful areas for research can also be identified. This is illustrated through the use of an example problem. (Author's abstract)
W88-00463

KINETIC MODEL FOR A FLUIDIZED-BED BIOREACTOR FOR DENITRIFICATION OF WASTEWATERS,
Oak Ridge National Lab., TN. Chemical Technology Div.
C. W. Hancher, and J. J. Perona.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-015696. Price codes: A02 in paper copy, A01 in microfiche. 1982. 18 p, 5 fig, 2 tab, 5 ref.

Descriptors: *Wastewater treatment, *Denitrification, *Nitrates, Biological treatment, Fluidized beds, Nitrites.

A fluidized bed bioreactor was operated continuously for a period of seven months for nitrate removal from an aqueous stream. The fluidized particles were 30- to 60-mesh anthracite coal supporting a fixed biofilm. The reactor was composed of two vessels in a series, each 20 cm in diameter and with an operating height of 6.3 m. The nitrate concentration in the reactor feed ranged from 100 to 15,000 g/cu m. A model for nitrate removal was developed using Michaelis-Menten kinetics. Axial dispersion effects were considered to be negligible, and effectiveness factors were greater than 0.9 for most experimental conditions. The effluent nitrite concentration peaked sharply at a feed nitrate concentration of 4400 g/cu m. At higher concentrations the nitrite decomposition rate depended on the nitrate concentration to about the 0.4 power. (Author's abstract)
W88-00472

ADEQUACY OF DISINFECTION FOR CONTROL OF NEWLY RECOGNIZED WATERBORNE PATHOGENS,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
J. C. Hoff, and E. E. Geldreich.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152181. Price codes: A02 in paper copy, A01 in microfiche. EPA-600/D-83-001, 1982. 14 p, 3 fig, 3 tab, 39 ref.

Descriptors: *Bacteria, *Viruses, *Disinfection, *Public health aspects, *Water treatment, Epidemiology, Epidemics, Drinking water, Potable water, Protozoa.

Agents recently recognized as causes or potential causes of waterborne outbreaks include pathogenic bacteria (Campylobacter jejuni, Yersinia enterocolitica), viruses, (rotavirus, Norwalk virus and other poorly defined viral agents) and Giardia lamblia, a protozoan agent. Although not a cause of waterborne disease in the classical sense, concern also has been expressed about the relationship of water supplies to the occurrence of legionellosis caused by Legionella pneumophila. New disinfection information on hepatitis A virus (HAV), long established as a cause of waterborne disease, has recently been developed and is included in this report. With the possible exception of Giardia lamblia, waterborne outbreaks caused by these agents seem to occur mainly as a result of deficiencies in treatment, massive contamination of water sources that received inadequate treatment, or contamination after treatment. There is little to indicate that such outbreaks occur in well-operated systems with adequate or conventional treatment. (Halterman-PTT)
W88-00475

ECOLOGICAL ASPECTS OF USED-WATER TREATMENT, VOLUME 3: THE PROCESSES AND THEIR ECOLOGY.
Academic Press, London. 1983. Edited by C. R. Curds and H. A. Hawkes. 340 p.

Descriptors: *Biological wastewater treatment, *Aerobic processes, *Membrane filters, *Biofilters, *Activated sludge process, Wastewater treatment, Activated sludge, Mathematical models, Design criteria, Ecological effects, Membrane processes, Biofiltration.

This volume of a three volume series examines aerobic captive-film systems for wastewater treatment. It is divided into three subject areas: biological filters, kinetics and mathematical modeling, and the applied significance of ecological studies of aerobic processes. The section on biological filters deals with the historical development of biological filters, their structural features, biological features and mechanisms of purification, forms of biological filtration and fields of application, systems of operation and performance capabilities, factors affecting performance, operational aspects, research aspects, and other captive-film systems. The section on kinetics and mathematical modeling examines computer simulation, stoichiometry, basic kinetic relationships, reactors, and steady-state and dynamic models. The section on the applied significance of ecological studies of aerobic processes contains an historic review of ecological studies, data on the role of biological processes in the treatment of used waters, autecological considerations, synecology of treatment processes, ecological approaches to the design and operation of activated-sludge plants, applied ecological studies on the film-fauna balance in biological filters, and ecological studies in the development of filter technology. (See W88-00476 thru W88-00478) (Geiger-PTT)
W88-00490

BIOLOGICAL FILTERS,
Water Research Centre, Stevenage (England).
A. M. Bruce, and H. A. Hawkes.
IN: Ecological Aspects of Used-Water Treatment, Volume 3: The Processes and Their Ecology, 1983. p 1-111, 23 fig, 12 tab, 185 ref.

Descriptors: *Biological filters, *Membrane filters, *Biofilters, Membrane processes, Contact beds, Biological wastewater treatment, Wastewater treatment, Aerobic processes, Activated sludge, Activated sludge process, Biofiltration, Contact filters.

Biological filters came into use in the United Kingdom in the late 1890's. In general, biological filters are circular in plan with rotary distributors. The depth of the filter is usually from about 0.9 to 15 m and modern percolating filters have a raised false floor of specially designed perforated tiles or floor blocks. Retaining walls are usually of brick, reinforced concrete or prefabricated concrete panels. The media should provide extensive surfaces and room for growth. Features of the bacteria, algae, protozoa, macro-invertebrates, and community balance of the biofilter are discussed. Low- and high-rate filtration are described, along with their use in different treatment processes. The structural and operational factors affecting performance of the biological filter are listed. The start-up, continuity and shock loading of filters are considered. The research aspects associated with biofilters that are examined are experimental filters, filter analogues, observational techniques, observations on film growth and accumulation, and liquid retention time. Other captive-film systems examined include contact beds, rotary biological filters, aerated submerged-bed filters, and anaerobic filters. (See also W88-00475) (Geiger-PTT)
W88-00491

KINETICS AND MATHEMATICAL MODELLING,
Cullen Coll. of Engineering, Houston, TX.
J. F. Andrews.
IN: Ecological Aspects of Used-Water Treatment, Volume 3: The Processes and Their Ecology, 1983. p 113-172, 27 fig, 68 ref.

Descriptors: *Biological wastewater treatment, *Anaerobic digestion, *Mathematical models, *Biological filters, *Model studies, *Dynamics, *Wastewater renovation, Wastewater treatment, Biofilters, Activated sludge, Activated sludge process, Anaerobic processes, Membrane processes, Contact filters, Kinetics, Biological treatment, Biological membranes, Recycling.

Mathematical models for the different types of reactors used in the biological treatment of wastewater can be developed by applying material and energy balances using the fundamental stoichiometric, thermochemical, and kinetic relationships. The biological reactions, stoichiometry, and basic kinetic relationships of organisms in the biological reactor system are reviewed. Reactors can be classified by the type or flow into and out of the reactor (batch and continuous-flow reactors) or by the amount of mixing provided (plug flow and complete mixing reactors). Models are developed for three types of reactors: a complete-mixing reactor with continuous and steady flow; a complete mixing reactor for which the organisms are separated from the liquid phase, concentrated, and recycled to the reactor; and a plug-flow, fixed-film reactor in which the organisms grow attached to surfaces in the reactor. Applications of these steady-state models on a quantitative basis are limited. Dynamic models are developed for a complete-mixing reactor, a complete-mixing reactor in series with recycle, and the anaerobic digestion process. (Geiger-PTT)
W88-00492

APPLIED SIGNIFICANCE OF ECOLOGICAL STUDIES OF AEROBIC PROCESSES,
Aston Univ., Birmingham (England).
H. A. Hawkes.
IN: Ecological Aspects of Used-Water Treatment, Volume 3: The Processes and Their Ecology, 1983. p 173-333, 69 fig, 9 tab, 164 ref.

Descriptors: *Biological wastewater treatment, *Aerobic processes, *Aerobic digestion, *Biofilters, *Biofiltration, Membrane processes, Contact filters, Biological membranes, Wastewater renovation, Wastewater treatment, Biological treatment, Design criteria, Activated sludge process, Activated sludge.

A historical review of ecological studies of aerobic processes is given along with a discussion of the role of biological processes in the treatment of wastewaters. Autecological consideration in the aerobic process are nutrient supplies, pH, toxicity to the digesting organisms, aeration and reactor temperatures. The synecology of the activated sludge process includes studies of the community structure, activity and interrelationships. Unlike the truly aquatic habitat of the activated sludge, the percolating filter supports a community containing moisture-loving, air-breathing, macroinvertebrates as well as the aquatic microorganisms. The film community and the grazing fauna community of the biofilter and their interractions are considered. A comparison of aerobic treatment processes is given. An ecological approach to the design and operation of activated-sludge plants takes into consideration sludge loading, sludge age, relationship of plant performance and sludge loading to sludge age, methods of controlling sludge loading, and the ecological aspects of other modified activated sludge systems. Applied ecological studies on the film-fauna balance in biological filters are described. Ecological studies in the development of filter technology cover topics of recirculation, alternating double filtration, frequency of dosing, double filtration, and high-rate filtration. (See also W88-00475) (Geiger-PTT)
W88-00493

METHOD AND RESERVOIRS FOR IN-GROUND CONTAINMENT OF LIQUID WASTE,
PPG Industries, Inc., Pittsburgh, PA.
For primary bibliographic entry see Field 5E.
W88-00505

METHOD FOR STABILIZATION OF SLUDGE,
Velsicol Chemical Corp., Chicago, IL.
G. N. King.
U.S. Patent No. 4,615,809; October 7,1986. 10 p, 3 fig, 11 tab, 1 ref. Official Gazette of the United States Patent Office, Vol 1071, No 1, p 272-273, October 7, 1986.

Descriptors: *Patents, *Sludge, *Liquid wastes, *Waste treatment, *Industrial wastes, Organic wastes, Mixing, Solid wastes, Fly ash, Calcium sulfite, Calcium compounds, Sludge disposal, Lime, Portland cements, Sludge stabilization, Solidification.

The stabilization is described of organic sludge comprising liquid or semiliquid industrial waste. The method consists essentially of mixing the sludge with 20 to about 75% fly ash, 11 to 54% calcium sulfate dihydrate, and 0.1 to 10% lime, and adding sludge. The cement is added last to maximize its function as a binder for the stabilized sludge composition. The method provides a means for solidifying organic sludges to a soil-like consistency. The sludge can then be handled with conventional earth-moving equipment, resulting in substantial savings to an organic sludge disposal operation; it allows cured sludge to be compacted to densities that show very low water permeability and high stability, thus maximizing the danger of leaching, contamination of groundwater, and run-

off after the waste has been permanently sited; it permits the treated waste to be shaped uniformly to a desired gradient without settling or distortion, thus facilitating the use of remedial programs such as conventional liners and capping; and it allows the treated sludge, if need be, to be easily transported to more suitable landfill sites. (Cremmins-AEPCO)
W88-00506

CONTROLLED GEL TIME FOR SOLIDIFICATION OF MULTI-PHASED WASTES,
Chem-Technics, Inc., Atlanta, GA.
J. R. Conner.
U.S. Patent No. 4,600,514; July 15, 1986. 7 p, 2 tab, 2 ref. Official Gazette of the United States Patent Office, Vol 1068, No 3, p 1208, July 15, 1986.

Descriptors: *Patents, *Gels, *Liquid wastes, *Waste treatment, *Solidification, Silicates, Cements, Waste disposal, Alkali metals, Timing, Mixing, Gellation.

Controlling the gel-time solidification of the multi-phased liquid of semi-liquid wastes is achieved by incorporating solid and liquid silicates in the cement-alkali metal silicate solidification system. The solid causes relatively slow gellation times, while the liquid silicate thickens the suspension rapidly by partial gellation. By varying the ratio of solid to liquid silicate in the waste solidification procedure, the gel time can be adjusted to be rapid enough to prevent phase separation while allowing sufficient time for processing the multi-phase waste material. The method is relatively inexpensive when compared to a solidification system that uses only a solid alkali-metal silicate. It also has the ability to optimally adapt the gelling time to a particular combination of multi-phased liquid or semi-liquid wastes. The amount of liquid silicate used will depend on the type of waste being treated, temperature, and the desired viscosity increase. The system is easy to control and to tailor to various types of mixers and wastes handling equipment. Also, it allows in-process adjustments to be made for changes in the composition or properties of the waste during treatment. (Cremmins-AEPCO)
W88-00508

METHOD OF PROCESSING WASTE MATERIALS, PARTICULARLY SLUDGE CONTAINING NOXIOUS METALS,
Pelt and Hooykass B.V., Rotterdam (Netherlands).
C. W. J. Hooykass.
U.S. Patent No. 4,601,832; July 22, 1986. 5 p. Official Gazette of the United States Patent Office, Vol 1068, No 4, p 1680, 1986.

Descriptors: *Patents, *Sludge, *Dredging, *Harbors, *Metals, *Noxious metals, Waste treatment, Acids, Fly ash, Iron, Manganese, Odors, Waste storage, Hydroxides.

Waste materials, including dredged harbor sludge containing noxious metals, are treated with an acid solution of a group VIIa or VIII metal, preferably iron or manganese. The metal dissolved in the acid is precipitated as a metal hydroxide and the noxious metal(s) dissolved from the waste by the acid solution are incorporated in the precipitating metal hydroxide. The waste material together with precipitated metal hydroxide is immobilized. Manganese hydroxide is particularly suitable for removing cadmium. An acid solution of iron, and preferably simultaneously manganese, for treating the waste is obtained by dissolving oxysludge caught during iron or steel manufacture. The dredge sludge may be formed into granules after mixing with a preformed mixture of a binder and 50 to 90% of the total amount of fly ash. Subsequently, the granules are treated with this fly ash. Carbon black and/or a water repellent substance may be added to the remaining amount of fly ash. No noxious metals are leached from the waste materials to be stored, so that the formation of deposits is possible. The waste materials may be used for elevating the soil bottom and to fill cavities formed by sand sucking. (Cremmins-AEPCO)
W88-00510

RETRIEVABLE JET MIXING SYSTEMS,
M. G. Mandt.
U.S. Patent No. 4,618,426; October 21, 1986. 11 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1071, No 3, p 1201, October 21, 1986.

Descriptors: *Patents, *Wastewater treatment, *Aeration, *Oxidation, *Jets, *Aerobic treatment, Cleaning, Mixing, Pumps, Reservoirs, Nozzles.

A jet aeration system for wastewater treatment may be readily cleaned or otherwise serviced without interrupting the operation of the wastewater treatment basin. The system includes a wastewater treatment reservoir for retaining the wastewater to be aerated and an air delivery system for providing an oxygen containing gas, such as air. The air delivery system comprises an upstanding conduit affixed at a predetermined position within the reservoir. A retrievable jet aerator provides at least one primary motive stream of liquid wastewater from within the reservoir. A jet mixing nozzle combines the stream with a secondary fluid and discharges the combined primary motive liquid and secondary fluid into the wastewater contained in the reservoir. (Cremmins-AEPCO)
W88-00511

PROCESS AND EQUIPMENT, IN PARTICULAR FOR THE CONDITIONING OF WASTE WATER SLUDGES,
Uhde (F.) G.m.b.H., Dortmund (Germany, F.R.).
H. E. Siekmann, J. Bassler, and W. Liebig.
U.S. Patent No. 4,617,130; October 14, 1986. 4 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1071, No 2, p 745, October 14, 1986.

Descriptors: *Patents, *Cavitation, *Fluid mechanics, *Wastewater treatment, *Sludge conditioning, *Suspended solids, Reservoirs, Pipes, Nozzles, Condensation, Biological wastewater treatment.

Cavitation is formed to treat liquid and solid mixtures, particularly by conditioning suspended solids. Impact condensation is created to destroy the cell-walls of biological substances within the mixture by the steps of containing the material mixture in a high-level reservoir, withdrawing it from the reservoir, and passing it through at least one pipe bend. The bend consists of a horizontally extending first section extending from the reservoir and a vertically extending second section extending downwardly from the first section. This provides a down pipe from the second section, and effects a pressure reduction in the material flowing downwardly through the pipe bend for impact condensation. (Cremmins-AEPCO)
W88-00512

BILGE SYSTEM,
Texas Oil Spill Control, Inc., Conroe.
For primary bibliographic entry see Field 5G.
W88-00513

METHOD FOR THE TREATMENT OF WASTEWATER SLUDGE,
Process Research Development and Management, Inc., Hoboken, NJ.
J. M. Lynch, J. R. Pfafflin, C. Pecker, R. Cardenas, and S. Cunningham.
U.S. Patent No. 4,500,428; February 19, 1985. 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1051, No 3, p 1178, February 19, 1985.

Descriptors: *Patents, *Sludge drying, *Waste treatment, *Wastewater treatment, *Aeration, *Dewatering, *Reaction vessels, Sludge, Hydrogen ion concentration, Wastewater oxidation, Oxidation, Bulking sludge, Energy sources, Landfills, Pressurization.

Economic reduction of the bulk of treated sludge yields a final product suitable for landfill operations or as an energy source through combustion. This method of treating wastewater sludge comprises a reaction vessel for the sludge, into which a pH depressant, an oxidizing agent, and air are introduced. The vessel is pressurized and sludge is withdrawn from it and reintroduced to it over a period of 15 to about 60 minutes. The sludge is dewatered; conducted to a second vessel; exposed to air, ozone, and lime; and discharged after a like period of time. The solid and liquid constituents are separated from the discharged sludge, and the latter is returned to the first vessel. (Cremmins-AEPCO)
W88-00516

METHOD OF PURIFYING WASTE WATER,
Centre de Recherches Metallurgiques, Liege (Belgium).
C. Josis, A. Hans, and T. Martens.
U.S. Patent No. 4,396,463; August 2, 1983. 5 p, 4 fig, 1 tab. Official Gazette of the United States Patent Office, Vol 1033, No 1, p 235, August 2, 1983.

Descriptors: *Patents, *Industrial wastewater, *Wastewater treatment, *Ammonium compounds, *Phenols, Hydrogen ion concentration, Acidic water, Pollutants, Vaporization, Stripping.

Wastewater to be purified, such as water from coking plants, is supplied to the upper part of a stripping column comprising substantially horizontal plates disposed above one another. Vapor is supplied to the lower part of the column. The water to be stripped is passed downwardly from the top of the column across a number of successive plates sufficient to permit the water to become acidic, with a pH decreasing to a value below 7. During the elimination of volatile ammonium compounds in the upper zone of the stripping column, the pH of this zone decreases naturally and progressively from the top to the bottom of this zone. This decrease may continue until the local pH value, in contrast to known methods in which the pH value remains above 7, drops to values lower than 7, and may reach 4. Below a pH value of 7 there is a natural acid zone favorable to the elimination of a considerable proportion of acidic pollutants and in particular phenol constituents (such as carbolic acid, cresols and xylenols), cyanides (such as hydrocyanic acid and sulphocyanides), and carbonates (such as carbonic acid and bicarbonates). (Cremmins-AEPCO)
W88-00520

SURFACE-ACTIVATED COMPOSITIONS AND METHOD FOR DISPERSING OIL SLICKS,
Cosen Technology, Inc., Dallas, TX.
For primary bibliographic entry see Field 5G.
W88-00523

LIQUID PURIFICATION SYSTEM,
For primary bibliographic entry see Field 3A.
W88-00527

FLUID TRANSPORT AND PROCESSING SYSTEM,
For primary bibliographic entry see Field 5G.
W88-00528

SULFITE DESTRUCTION OF DIRECT ACTING MUTAGENS IN DRINKING WATER,
Minnesota Univ., Minneapolis. Regents.
For primary bibliographic entry see Field 5F.
W88-00533

REGENERATION OF ACTIVATED CARBON AT AMBIENT TEMPERATURES USING SUPERCRITICAL SOLVENTS,
Delaware Univ., Newark. Dept. of Chemical Engineering.
M. E. Paulaitis.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201091/AS. Price codes: A02 in paper copy, A01 in microfiche. Delaware Water Resources Center, Newark. Final Report, Annual Cooperative Program Project, June 1983. 5 p, 5 ref. Project No. OWRT A-045-DEL (3). Contract No. 14-34-0001-0108.

Descriptors: *Wastewater treatment, *Activated carbon, *Adsorption, *Phenolic compounds, Phenol, Chlorophenols, Solubility, Carbon dioxide.

Solubilities of phenol, p-chlorophenol, and 2,4-dichlorophenol were measured in supercritical carbon dioxide. Adsorption isotherms on Amoco GX-31 activated carbon were measured for phenol in aqueous solutions and in solution with supercritical carbon dioxide. Equilibrium loadings of phenol from supercritical carbon dioxide onto previously regenerated samples of activated carbon were measured in order to examine irreversibilities in the adsorption process. A thermodynamic formulation is presented for correlating solubilities in a supercritical fluid. This correlation is used in conjunction with the aqueous adsorption isotherms to predict adsorption isotherms from supercritical carbon dioxide. Model predictions are compared with experimental results for the phenol/supercritical carbon dioxide/Amoco GS-31 activated carbon system. Interpolation and limited extrapolation using this model is demonstrated. The preliminary conclusion that can be reached from these observations is that supercritical carbon dioxide appears to offer no significant thermodynamic advantage for regenerating activated carbon saturated with strongly adsorbed solutes such as phenol. (Author's abstract)
W88-00541

FORMATION AND REMOVAL OF BROMOFORM DURING DESALINATION,
North Carolina Univ. at Charlotte. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 3A.
W88-00546

DEVELOPMENT OF THE NUTRIENT FILM TECHNIQUE FOR RENOVATION OF WASTEWATER FOR NONPOTABLE USE: DESIGN CRITERIA STUDY,
Florida International Univ., Miami. Drinking Water Research Center.
L. Handley-Raven, L. S. Casey, J. L. Lopez, A. Perez, and W. J. Cooper.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197356/AS. Price codes: A03 in paper copy, A01 in microfiche. Final Report, March 1987. 41 p, 1 fig, 7 tab, 20 ref, append. Contract No. USGS 14-08-0001-G1065.

Descriptors: *Wastewater treatment, *Wastewater renovation, *Biological treatment, *Nutrient film technique, Hydroponics, Nonpotable reuse, Water reuse, Root zone biotechnology, Gravel bed hydroponics, Grasses.

The nutrient film technique (NFT), gravel bed hydroponics (GBH), and root zone biotechnology (RBZ) are all techniques which have been promoted recently as appropriate for wastewater renovation. They all depend upon continuous horizontal (lateral) flow of wastewater through the roots of crops. Outdoor study in a semi-tropical setting, using a proven wastewater renovation crop species, Brachiaria mutica, demonstrated that it was not possible to maintain this flow regime. Hence, wastewater renovation was no better than existing technologies such as effluent irrigation. The systems studied, (NFT and GBH), were much more elaborate than effluent irrigation and much more difficult to maintain. Independent assessments of RZB's in Europe and unpublished data from NFT and GBH work in Portsmouth, England substantiate these results. A batch-loaded and slow-drainage system operated concurrently at the same site performed substantially better with much less maintenance and far fewer problems. Crop growth was also better. (Handly-Raven-FL Internat. U.)
W88-00552

METHOD AND AN INSTALLATION FOR PURIFYING INDUSTRIAL WASTE WATER, PARTICULARLY PROCESS WATER FROM DYEING WORKS,
P. A. Henriot.
U.S. Patent No. 4,574,036; March 4, 1986. 5 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1064, No 1, p 292, March 4, 1986.

Descriptors: *Patents, *Wastewater treatment, *Industrial wastewater, *Evaporation, *Dye industry wastes, *Heating, *Physico-chemical treatment, Coagulation, Flocculation, Filtration, Chemical oxygen demand.

Dyeing wastewater containing high chemical oxygen demand and fine particulates in suspension is treated by directly heating and evaporating the polluted water without pretreatment. After condensing, the evaporated water is subjected to a physical chemical purifying process utilizing coagulation, flocculation, and filtration. The produced water is pure enough to be recycled through the originating dyeing process. The system includes a multi-staged evaporator which uses the vapor from each stage (other than the first) to evaporate the water in the next stage. The first stage water is pre-heated using an economizer whose source is the final evaporative water vapor which condenses in the source water tank and thus heats it. The evaporation process manifests a synergistic effect on the subsequently performed physical chemical operations; that is, the water obtained at the end of the process is sufficiently de-polluted to require lower chemical dosage and thus resulting in reduced quantities of sludge production. (Hancuff-AEPCO)
W88-00577

WASTE EFFLUENT TREATMENT AND SOLVENT RECOVERY SYSTEM,
F. Lucas.
U.S. Patent No. 4,495,034; January 22, 1985. 8 p, 12 fig. Official Gazette of the United States Patent Office, Vol 1050, No 4, p 1507, January 22, 1985.

Descriptors: *Patents, *Waste recovery, *Solar distillation, *Organic solvents, *Chemical recovery, *Waste treatment, Wastewater treatment, Separation techniques, Capillary conductivity, Solvents, Chemical wastes, Water pollution control, Recycling, Effluents.

Recyclable organic or water solvents are separated by solar distillation. Pure water from dissolved solids mixtures, turpentine from paint/turpentine solutions, and volatile organic solvents with trace water or dissolved solid contamination are recovered. One system reservoir holds the waste effluent, while a second reservoir is part of the process itself. The latter reservoir is covered with an A-frame solar unit comprised of glass panels which form a collecting dome. The unit also contains collecting troughs, a bonnet to shade the top of the pyramid formed by the panels, and mirrors for the reflection of sunlight. The flow from the first reservoir moves into an elevated trough, which is draped on either side with a cloth or absorbent material designed to contact the fluid in the secondary reservoir beneath the trough. The solar distillation of solvents is accomplished by placing the apparatus in direct sunlight. As the solvents move up the cloth through capillary action (wicking) it tends to vaporize and the vapor condenses on the inside of the glass A-frame. The high angle tilt of the glass, 55 to 60 degrees, allows very small drops to overcome their adhesive properties to the glass and flow with the aid of gravity into the collection troughs set at an angle of 4 degrees to aid the flow. The collection system can be equipped with a chemical trap for the recovery of the solvent of interest. The trap may contain activated charcoal or an anion/cation exchange resin when pure water is desired. (Hancuff-AEPCO)
W88-00580

METHOD AND APPARATUS FOR PRE-DILUTION OF DRILLING MUD AND SLURRY AND THE LIKE,
Atlantic Richfield Co., Los Angeles, CA.
W. F. Priebe.
U.S. Patent No. 4,548,525; October 22,1985. 5 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1059, No 4, p 1709, October 22, 1985.

Descriptors: *Patents, *Dilution, *Waste disposal, *Oilfield wastes, *Drilling, *Flow discharge, *Mud, *Wastewater disposal, *Slurries, Wastewater treatment, Mudflow, Jets, Stream discharge, Conduits, Mixing, Process water, Aspiration.

Spent drilling mud slurry or produced water is diluted by expelling it into a submerged conduit to form an expanded jet stream. As the jet stream moves through the conduit, it aspirates and entrains a quantity of the surrounding water whereby the fluid is diluted. A blade system is interposed within the pipe in the path of the fluid stream to produce turbulence and mixing of the fluid to a more uniform consistency. A system may be provided for continuous alignment of the conduit with the existing current in the body of receiving water. Additionally, the conduit may be slanted downwardly with respect to the horizontal to compensate for the downwardly skewing effect on the fluid jet stream of the force of gravity. (Cremmins-AEPCO)
W88-00588

FLOW DIVIDER FOR DISTRIBUTION SYSTEMS,
For primary bibliographic entry see Field 8C.
W88-00595

FLOW REGULATION DEVICE FOR WASTE WATERS,
R. Filippi.
U.S. Patent No. 4,455,231; June 19, 1984. 5 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1043, No 3, p 1144-1145, June 19, 1984.

Descriptors: *Patents, *Flow regulators, *Storm runoff, *Weirs, *Flood flow, *Wastewater collection, *Rainfall, Flow control, Flow discharge, Flood routing, Wastewater management, Rainfall distribution, Thunderstorms.

A flow regulating device transmits wastewater mixed with clean rainfall to a purification station during a flood or after a thunderstorm. The flow regulator comprises a collection chamber with a first inlet opening for receiving the mixed waters, a second outlet opening for discharging mostly wastewater, and a third outlet opening for discharge mostly clean rain water. The collection chamber further comprises a waste-weir to guide a predetermined quantity of mixed water with a high content of wastewater from the first toward the second opening, and for guiding the surplus mixed waters with a high content of clean water from the first opening into the collection chamber and towards the third opening. The device also contains a reduction adapter located upstream of the waste-weir. The adapter includes a tapered cylinder, the small diameter of which corresponds to the diameter of a supply duct supplying mixed water to the first inlet opening. The adapter also includes an overflow component connected to the upper partition of the tapered cylinder. (Cremmins-AEPCO)
W88-00596

PROCESS FOR THE UTILIZATION OF WASTE WATERS IN THE HYDROGENATION OF COAL,
Ruhrkohle A.G., Essen (Germany, F.R.).
For primary bibliographic entry see Field 3C.
W88-00598

SEWERAGE FLOW DIVERTER,
K. P. Cousino.
U.S. Patent No. 4,578,188; March 25, 1986. 7 p, 7 fig. Official Gazette of the United States Patent Office, Vol 1064, No 4, p 1774, March 25, 1986.

Descriptors: *Patents, *Sewer systems, *Wastewater facilities, *Storm water, *Flow regulators, *Diversion structures, Wastewater treatment, Flow control, Bypass channels, Weirs, Interceptor sewers, Storm drains.

A sewerage flow diverter directs low volumetric liquid flow and heavier constituents of sewerage from a large combined storm water and sewage drain, conduit, or pipe into a sanitary interceptor. The diverter also directs high volumetric liquid flow of combined storm water and sewerage to bypass a sanitary interceptor. The diverter comprises a hollow weir positioned in the bottom of the large storm water and sewage drain. An open

space between the drain inlet and outlet pipes allows the flow to fall downward from inside the hollow weir to an interconnect pipe leading to the sanitary interceptor. At low flow rates, the liquid in the bottom of the large drain is primarily sewerage, which possesses relatively low kinetic energy as it enters the inlet pipe in the weir. Within the weir, the liquid drops through the opening and passes on to the sanitary interceptor. With increasing volumetric liquid flow in the large drain, the kinetic energy of the liquid entering the inlet pipe increases, thereby causing increasing amounts of liquid to flow across the opening and pass through the outlet pipe back into the large drain. (Cremmins-AEPCO)
W88-00599

SUBSURFACE WASTE DISPOSAL SYSTEM,
Genstar Waste Transfer, Inc., San Mateo, CA.
For primary bibliographic entry see Field 5E.
W88-00603

METHOD FOR THE ULTIMATE DISPOSAL OF HIGH LEVEL RADIOACTIVE WASTE,
Chevron Research Co., San Franciso, CA.
For primary bibliographic entry see Field 5E.
W88-00604

PROCESS FOR CONTAINMENT OF LIQUIDS AS SOLIDS OR SEMISOLIDS,
Agritec, Inc., Houston, TX.
For primary bibliographic entry see Field 5E.
W88-00613

MOBILE SLUDGE HANDLING APPARATUS,
Feluwa, Schlesiger and Co. K.G. Muerlenbach (Germany, F.R.).
J. Schlesiger.
U.S. Patent No. 4,655,916; April 7, 1987. 4 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1077, No 1, p 360, April 7, 1987.

Descriptors: *Patents, *Sludge conditioning, *Sludge disposal, *Mining engineering, *Drainage systems, *Wastewater treatment, *Slurries, Sludge drying, Pumps, Sludge filters, Conveyance structures, Underground structures.

Mining sludge is drained and transported using an underground device comprising container, filter unit, and conveyance vehicles. The container vehicle includes a container for receiving sludge, a system for agitating the sludge in the container, and a pump to pump the sludge from the container to the filter unit vehicle. The filter vehicle includes a chopper for receiving and crushing filter cakes and a conveyor for conveying the crushed filter cakes to the conveyor vehicle. The conveyor vehicle receives the crushed filter cakes from the first conveyor. (Cremmins-AEPCO)
W88-00617

LOS ANGELES COUNTY EXPERIENCE IN THE CONTROL AND TREATMENT OF INDUSTRIAL WASTEWATER DISCHARGES,
Los Angeles County Sanitation Districts, Whittier, CA.
L. S. Directo, C. W. Carry, and J. F. Kremer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142331. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 272-299, 14 fig, 3 tab.

Descriptors: *Wastewater treatment, *Wastewater, *Industrial wastewater, Wastewater purification, Regulations, Legal aspects, Heavy metals, Los Angeles, California.

The Sanitation Districts of Los Angeles County adopted, on April 1, 1972, an ordinance regulating industrial wastewater discharges. This ordinance established a number of industrial waste regulatory programs which included industrial waste permits, an industrial surcharge program, industrial plant inspections, and wastewater monitoring and enforcement activities. The basic element of the industrial waste source control program is the implementation of the Phase I industrial wastewater effluent limits, which have been strictly enforced since July 1, 1977. The effluent guidelines established discharge limits for cyanide, heavy metals, and total identifiable chlorinated hydrocarboas. The impact of major industrial companies on the Los Angeles County Sanitation Districts' Joint Outfall sewage system and wastewater treatment facilities, and the role of the Districts in the implementation and enforcement of Phase I limits, are discussed. (Halterman-PTT)
W88-00623

COMBINED MUNICIPAL-INDUSTRIAL WASTEWATER TREATMENT IN GARLAND, TEXAS,
Texas Univ. at Dallas, Richardson.
A. Netzer, J. McNutt, and W. B. Dollar.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142349. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, TX. Robert S. Kerr Environmental Research Lab., April 1981. p 300-312, 1 fig, 4 tab, 5 ref.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Industrial wastewater, Wastewater, Wastewater purification, Biological treatment, Chemical treatment, Physicochemical treatment.

The Duck Creek Wastewater Treatment Plant is a combined municipal-industrial treatment facility serving the City of Garland, Texas and portions of the cities of Sachse, Mesquite, Sunnyvale, and Dallas, Texas. The municipal effluents are from a population of over 150,000 and the industrial discharges are from over 400 various light industries, ranging from paint manufacturing and metal plating to food and dairy processing. Due to growth of both population and industry serviced by this combined municipal-industrial wastewater system, the Duck Creek Wastewater Treatment Plant was recently upgraded from its original 10 MGD biological treatment facility to a 30 MGD facility by the addition of a 22.5 MGD physical-chemical treatment process. Pretreatment consists of trash screening, a 60 MG equalization basin with brush aerators, bar screening and grit removal. The biological treatment process consists of primary clarification, primary trickling filters, intermediate clarification, secondary trickling filters, and final clarification. The physical-chemical treatment process consists of coagulation-flocculation with lime, ferric chloride, and polyelectrodes, clarification recarbonation, and ultrahigh rate sand filtration. Final treatment for both systems consists of granular activated carbon adsorption and chlorine disinfection. (Author's abstract)
W88-00624

TREATMENT OF COTTON WASTE IN THE MERSEY BASIN,
Sheffield City Polytechnic (England). Dept. of Civil Engineering.
G. M. Doughty.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142356. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, TX. Robert S. Kerr Environmental Research Labs., Ada, OK, April 1981. p 313-328, 1 fig, 8 tab, 20 ref.

Descriptors: *Wastewater treatment, *Wastewater, *Cotton, Textiles, Industrial wastewater, Biological treatment, Wastewater purification, United Kingdom, Mersey River Basin, River Goyt, England.

Many of the streams of North West England, the traditional home of the UK cotton industry, are still heavily polluted by industrial discharges. Severe pollution of the River Goyt, a tributary of the Mersey, results from a cotton processing effluent, much of which is treated in admixture with domestic sewage at Whaley Bridge Effluent Treatment Works (E.T.W.). Although the works was extended in 1967 and is not hydraulically overloaded, the acceptance of strong liquors from the Kiering operation of the cotton processor has resulted in a gross organic overload. After hydraulic balancing and neutralization at the trade premises, a highly colored liquor with a BOD estimated at 8000 mg/L is sewered to the E.T.W. In current extension of the E.T.W. by North West Water Authority, conventional biological treatment is to be upgraded to high-rate filters followed by oxygen activated sludge (UNOX). To aid dilution of the trade effluent to outdated downstream E.T.W.'s are to close and their process flows pumped upstream to Whaley Bridge. A high degree of flexibility is incorporated in the design with only the highly polluted flows passing through all the biological stages. The extended works have been designed with the aim of achieving a 30/20 effluent standard, although further development work is considered necessary to eliminate high coloration. (Author's abstract)
W88-00625

CASE STUDY OF A POTATO CHIP PRODUCER DISCHARGING TO A SMALL MUNICIPAL TREATMENT SYSTEM,
Reid, Crowther and Partners Ltd., Don Mills (Ontario).
A. W. Wilson.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 329-352, 3 fig, 7 tab, 12 ref.

Descriptors: *Wastewater treatment, *Wastewater, *Food processing wastes, Industrial wastewater, Pretreatment, Municipal wastewater, Sampling, Water sampling, Wastewater treatment facilities, Potatoes, Food processing industry.

An investigation was made of the causes of chronic upset conditions at a small municipal treatment plant receiving a large proportion of potato chip processing wastewater. The investigation encompassed a review of effluent loadings from the potato chip production processes, improvement of pre-treatment facilities and separate treatment of the caustic waste generated during cleaning of the fryers. Not all of the problems at the sewage treatment plant were due to the potato processing wastes. Periodic hydraulic surging caused by a sewage pumping station was impairing the performance of the primary treatment system. A marginal nutrient limiting condition in the secondary section of the treatment plant was identified, and an appropriate operating range for the process control parameters was recommended. The importance of collecting representative composite samples to provide an accurate reflection of the loadings on the treatment plant was noted. (Author's abstract)
W88-00626

JOINT TREATMENT DESIGN AND OPERATION PROBLEMS WITH A FINE PAPER MANUFACTURING WASTEWATER,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142372. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 353-380, 14 fig, 2 tab, 4 ref.

Descriptors: *Wastewater treatment, *Pulp and paper industry, *Municipal wastewater, Wastewater, Industrial wastewater, Wastewater treatment facilities, Penobscot River, Maine.

The efforts to evaluate and provide solutions to process problems encountered in a joint treatment facility are discussed. The 3.0 MGD facility receives municipal wastewater (from a city with a population of 10,000) and industrial wastewater

(fine paper making), has been plagued with operation problems since its startup in 1976. The technical aspects of the operation problems, with respect to design inadequacies and process operation; the technical solutions to the problems, which involved a field research effort; and the interactions between the city, industry, design consultant, state government, and the EPA (with emphasis on how each influenced the implementation of the technical solutions), are described. (Halterman-PTT)
W88-00627

UNIROYAL CHEMICAL'S EXPERIENCE WITH COMBINED MUNICIPAL-INDUSTRIAL WASTEWATER TREATMENT AT ELMIRA, ONTARIO,
Uniroyal Ltd., Elmira (Ontario). Chemical Div.
K. C. Bradley.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142380. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 381-387, 3 fig.

Descriptors: *Agricultural chemicals, *Rubber, *Wastewater treatment, *Industrial wastewater, Wastewater, Municipal wastewater, Wastewater facilities, Pretreatment of water.

Various aspects of combined municipal-industrial wastewater treatment are discussed, using an example of wastewater from a facility that produces a wide range of organics for use in agricultural and rubber chemical industries. Process wastewaters from this chemical complex are combined with raw sewage prior to primary clarification and secondary treatment. Some of the implications of the concept of combined treatment are presented, along with some thoughts on operating experience. Changes made, and proposed, to upgrade treatment include modifications to the aeration system, improved equalization, activated carbon pretreatment, and effluent filtration. Studies providing direction for these changes are discussed. (Halterman-PTT)
W88-00628

INDUSTRIAL COMPATIBILITY WITH THE POTW IN TAMPA, FLORIDA THROUGH CITY/INDUSTRY COOPERATION,
D. W. Pickard.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142398. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 388-394, 8 tab.

Descriptors: *Wastewater treatment, *Wastewater, Municipal wastewater, Industrial wastewater, Water treatment facility, Pretreatment of water, Sludge, Advanced wastewater treatment, Wastewater facilities.

A comprehensive industrial waste monitoring section was started on a full scale basis in 1973, five years before the new advanced water treatment plant construction was complete. The Tampa advanced water treatment plant treats waste from a service area with a population of 300,000 and approximately 50 key industries. Industries include breweries, food processors, lead storage battery manufacturing, electroplating, and printed circuit board manufacturing. Most pretreatment programs have involved industrial process changes in place of treatment plants, thus producing little toxic residue. Pilot plants of the advanced water treatment process selected for Tampa were run for approximately two years to verify the treatability of the wastewater by the process of choice. Thru planning and industrial cooperation Tampa has maintained a combined wastewater that is compatible with the publicity owned treatment works. (Author's abstract)
W88-00629

SOURCES OF TOXIC POLLUTANTS FOUND IN INFLUENTS TO POTW'S,
Environmental Protection Agency, Washington, DC.
R. Seraydarian, R. Frederick, and D. Ehreth.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142406. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 395-413, 7 fig, 5 tab, 5 ref.

Descriptors: *Wastewater treatment, *Wastewater, Industrial wastewater, Municipal wastewater, Water treatment facility, Wastewater facilities, Heavy metals, Solvents, Toxicity.

The origin and magnitude of the problem of toxic substances in publicly owned treatment works (POTW) are discussed. A major objective of the Monitoring and Data Support Division Study was to determine the relative significance of the major source types- residential, commercial and industrial - in contributing priority toxic pollutants to POTW influents. The collection systems from eleven residential areas, ten commercial areas, and five industry-dominated areas in four different cities were sampled. The influent to the POTW and tap water were also sampled. All of the 129 priority pollutants were looked for, but 67 were not found in collection systems of four POTW's. The most prevalent pollutants detected were metals, solvents, and phthalate ester plasticizers. Industrial sources appear to dominate the loading on the POTW for most pollutants, while residential and commercial contributors are still important for some pollutants, although at a lower total loading when industrial sources are not present. The type and size of industry present was a significant factor in detecting the presence and concentration levels of the priority pollutants. (Author's abstract)
W88-00630

TREATMENT AND REMOVAL OF PRIORITY INDUSTRIAL POLLUTANTS AT PUBLICLY OWNED TREATMENT WORKS,
Burns and Roe Industrial Services Corp., Oradell, NJ.
H. D. Feiler, P. J. Storch, and A. Shattuck.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142414. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 414-452, 2 fig, 14 tab.

Descriptors: *Wastewater treatment, *Wastewater, *Industrial wastewater, Municipal wastewater, Water treatment facilities, Wastewater facilities, Pollutants, Toxicity.

In 1978, the United States Environmental Protection Agency (EPA) embarked upon a program of study designed to elucidate the occurrence and fate of 120 selected toxic organic and inorganic pollutants (priority pollutants) in Publicly Owned Treatment Works (POTW's). The scope of this project includes week-long, round-the-clock sampling at 40 POTW's across the United States. Samples collected are subsequently analyzed for the priority pollutants as well as conventional and selected non-conventional parameters. Thus far, 20 POTW's have been sampled and data from nine plants has been obtained. The nine plants' data have been summarized and evaluated. Mechanisms for priority pollutant treatment and removal and the impact of industrial flow on POTW influent toxic pollutant concentrations are discussed. Removal efficiencies and approximate calculations of 'consistent removals' are presented. Finally, concentration factors for priority pollutants in POTW sludges and mass balances were calculated and are presented. (Halterman-PTT)
W88-00631

BEHAVIOR OF SELECTED TOXIC SUBSTANCES IN WASTEWATER COLLECTION AND TREATMENT SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
A. C. Petrasek.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142422. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 423-477, 7 fig, 15 tab, 2 ref.

Descriptors: *Wastewater treatment, *Wastewater, *Industrial wastewater, *Municipal wastewater, Pollutants, Toxicity, Organic compounds, Phenols, Heavy metals, Organic pesticides.

Research was conducted to provide information about the behavior of selected toxic substances in conventional water pollution control systems. Those materials analyzed include semivolatile organic priority pollutants and the heavy metals. The basic approach in this project is to operate parallel sequences of the unit processes. One treatment train is operated as a control; the other sequence has the organic compounds being studied added in a toluene solution. The initial spiking provides a concentration of 50 micrograms/L for most of the organic compounds being studied. All process flows, sludges, and off-gases are sampled so the behavior of the spiked chemicals and indigenous metals can be quantitated. Although not enough tests have been completed to provide definitive data on removal of these materials, especially metals, initial findings are that recoveries of organics range from 70 to 90% for the PAH's, from 70 to 100% for the phthalates, from 95 to 100% for phenols, and from 90 to 100% for the pesticides. (Halterman-PTT)
W88-00632

EFFECT OF COMBINED TREATMENT ON PRIORITY POLLUTANTS IN POTW'S,
Washington Univ., Seattle. Dept. of Environmental Health.
F. B. DeWalle, D. A. Kalman, and E. S. K. Chian.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142430. Price codes: A24 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 478-487, 6 fig.

Descriptors: *Wastewater treatment, *Wastewater, *Industrial wastewater, Municipal wastewater, Pollutants, Toxicity, Organic compounds, Sludge, Heavy metals.

The removal efficiencies of trace levels of priority pollutants in plants receiving variable amounts of industrial contributions are discussed. The results of studies indicate that industrial pretreatment control would probably be effective for chlorinated solvents, Cl/alkyl benzenes, and phenols, but not for phthalates. Primary treatment is effective for removing high molecular weight compounds that adsorb onto the solids that are removed during sedimentation. Secondary treatment is able to remove compounds that are volatile through air stripping in the aeration basin. Additional adsorption onto the bacterial solids occurs in the sludge aeration basins; adsorbable organics will accumulate in the primary and secondary sludge and thus pose a solids disposal problem. Source control, if practicable, should receive the highest priority in controlling the discharge and proliferation of compounds in the environment. (Halterman-PTT)
W88-00633

HEAVY METALS IN MUNICIPAL WASTEWATER TREATMENT PLANT INFLUENTS: AN ANALYSIS OF THE DATA AVAILABLE FROM TREATMENT PLANTS,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
R. A. Minear, M. W. Cantrell, R. L. Church, S. A. Hannah, and R. O. Ball.
Available from the National Technical Information

Service, Springfield, VA 22161, as PB83-142448. Price codes: A24 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 488-520, 7 fig, 17 tab, 4 ref.

Descriptors: *Heavy metals, *Wastewater facilities, Chemical analysis, Industrial wastewater, Municipal wastewater, Pollutants, Toxicity, Silver, Arsenic, Mercury, Beryllium, Cobalt, Antimony, Selenium, Aluminum, Iron, Manganese, Lead.

The preliminary results of a 2-year study involving the identification and assembly of a data base existing within the Publicity Owned Treatment Works (POTW) of the U.S. on influent heavy metals is presented. The general character of the data base with respect to associated descriptors (among which are % industrial contribution, % combined sewers, % infiltration/ inflow, sample frequency, sample type, analytical method) is provided. Wastewater treatment plant laboratories were evaluated in the conduct of the study and generally found to be satisfactory within the framework of the evaluation method. Of the 80,000 individual pieces of data from 239 wastewater treatment plants, a substantial data base was generated for cadmium, chromium, copper, nickel, lead and zinc. Extensive data (but reduced in total volume) were obtained for silver, arsenic, and mercury. Limited data were obtained for beryllium, cobalt, antimony and selenium. Aluminum, iron and manganese data were received well. Median and mean (computed in varying manner) are reported and compared. While no associations could be demonstrated between the median or mean values for the composite data base and the individual descriptors using Pearson and Spearman techniques, isolation of the low percent industrial waste category from the parent data base did show a significant difference for 6 of 7 metals. Lead was the metal not showing a difference. (Author's abstract)
W88-00634

SOURCES AND FLOW OF HEAVY METALS AND CYANIDE IN THE KOKOMO MUNICIPAL TREATMENT SYSTEM,
Purdue Univ., Lafayette, IN.
For primary bibliographic entry see Field 5B.
W88-00635

PROBLEMS WITH METALS IN THE RESIDUE FROM COMBINED MUNICIPAL/INDUSTRIAL WASTE TREATMENT,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-00636

ROLE OF MUNICIPAL WASTEWATER TREATMENT IN CONTROL OF TOXICS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
D. F. Bishop.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152447. Price codes: A03 in paper copy, A01 in microfiche. EPA-600/D-82-360, 1982. 35 p, 2 fig, 12 tab, 21 ref.

Descriptors: *Wastewater treatment, *Toxic wastes, *Priority pollutants, *Municipal wastewater, *Toxicity, Sludge, Activated sludge, Heavy metals, Pollutants, Water pollution control.

The U.S. EPA's Municipal Environmental Research Laboratory is assessing the treatability and removability of toxic substances from municipal wastewater by various treatment processes. The studies feature occurrence surveys, treatability studies to assess individual toxic removal mechanisms and pilot-scale plant removal studies using wastewater spiked with selected priority pollutants (metals and organics). In the plant removal studies, the treatment plant performance on spiked wastewater is usually compared to the performance of identical treatment on the unspiked raw wastewater. The assessments employ costly analyses (GC/MS and atomic adsorption methods) for the selected toxic substances in the various process streams and sludges of treatment plants. A biomonitoring approach to assess health and ecosystem effects is also being evaluated to supplement the specific toxic substance removal data. From the studies to date, conventional primary-activated sludge treatment is generally effective in removing toxic substances, typically achieving better than 90% removal of organics and from 60-80% removal of the metals. However, a number of the toxic substances were found in the plant final effluents at concentrations which, based upon EPA recommended water quality criteria may present a possible environmental hazard. (Author's abstract)
W88-00639

ANAEROBIC TREATMENT OF GASIFIER EFFLUENTS,
Georgia Inst. of Tech., Atlanta.
W. H. Cross, E. S. K. Chian, F. G. Pohland, M. Giabbai, and S. R. Harper.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-018230. Price codes: A03 in paper copy, A01 in microfiche. Quarterly Report 4, July 1982. DOE/FC/10297-T3. 35 p, 22 fig, 2 tab. Contract No. DE-AC18-81FC0297.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Effluents, *Wastewater analysis, *Performance evaluation, Biological wastewater treatment, Phenols, Ammonia, Nitrogen removal, Separation techniques, Activated carbon, Phosphates, Organic carbon, Chemical oxygen demand.

The quarterly report for Systems I and II of the anaerobic treatment systems show the total volatile acid concentration for influent, Raschig Ring effluent and activated carbon column effluent. Average daily gas production for the period day 147-194 for both systems was 1.2 L/day CO2 and 4.5 L/day CH4, with System I showing more variability in daily gas production that System II. During the period day 147-195 both Systems continued to show good phenol removal with ranges of removal efficiencies of 79-93% and 84-95% for Systems I and II, respectively. During the same period the TOC and COD removal averaged 67 and 76%, for System I while those for System II were 72 to 81%, respectively. The pH of the diluted wastewater ranged from 8.0 to 8.4 and decreased to 7.3 to 7.8 in the AC effluent until the systems failed at which time the pH in the effluent increased to a value of 8.0 to 8.3. System III has been acclimated to 10% raw wastewater and operated on a feed substrate of >10% raw wastewater and phosphates for a period of 51 days. The volatile acid production, gas production, phenol removal, TOC and COD removals, and pH, ORP and alkalinity changes which resulted from this measure are given. The nitrification system has shown extremely good removals of NH3, residual TOC, and COD in the wastewater. Problems in the operation of the continuous extraction system are described. Preliminary operations of the air stripping tower for ammonia removal show the need for certain improvements. (Geiger-PTT)
W88-00646

ENVIRONMENTAL REVIEW OF ONSHORE CANADIAN OIL AND GAS DRILLING AND PRODUCTION ACTIVITIES.
Zenon Environmental, Inc., Burlington (Ontario).
For primary bibliographic entry see Field 5E.
W88-00662

SYNTHETIC MEMBRANE PROCESSES: FUNDAMENTALS AND WATER APPLICATIONS.
For primary bibliographic entry see Field 3A.
W88-00700

MEMBRANE METHODS IN WATER AND WASTEWATER TREATMENT: AN OVERVIEW,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 5F.
W88-00701

MATHEMATICAL MODELING OF FLUID FLOW AND SOLUTE DISTRIBUTION IN PRESSURE-DRIVEN MEMBRANE MODULES,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 3A.
W88-00705

ELECTRODIALYSIS - MEMBRANES AND MASS TRANSPORT,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Applied Research Inst.
For primary bibliographic entry see Field 3A.
W88-00706

DESALTING EXPERIENCE BY HYPERFILTRATION (REVERSE OSMOSIS) IN THE UNITED STATES,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 3A.
W88-00707

DESALTING EXPERIENCE USING HYPERFILTRATION IN EUROPE AND JAPAN,
Gesamthochschule Essen (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-00708

WATER AND WASTEWATER TREATMENT EXPERIENCE IN EUROPE AND JAPAN USING ULTRAFILTRATION,
Fraunhofer-Inst. fuer Grenzflaechen- und Bioverfahrenstechnik, Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-00709

DESIGN, OPERATION, AND MAINTENANCE OF A 5-MGD WASTEWATER RECLAMATION REVERSE OSMOSIS PLANT,
I. Nusbaum, and D. G. Argo.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 377-436, 14 fig, 16 tab, 10 ref.

Descriptors: *Wastewater treatment, *Ultrafiltration, Membrane processes, Membranes, Demineralization, Filtration, Water treatment, Municipal wastewater.

The planning, development, design and operation of a 5-mgd reverse osmosis plant operating on an advanced water treatment effluent is presented. Following a description of the wastewater treatment plant which supplies the effluent, the reverse osmosis plant is described. A detailed process description, including pretreatment, reverse osmosis, and post treatment is presented. Plant performance is discussed, with an emphasis on design assumptions, start-up performance and the results of the plant operation. Further discussions on membrane hydrolysis, membrane fouling, membrane compaction, and other physical effects of filtration on the membranes are also provided. A summary of the costs of reverse osmosis demineralization is presented. (See also W88-00700) (Halterman-PTT)
W88-00710

DESIGN AND OPERATION OF DESALTING SYSTEMS BASED ON MEMBRANE PROCESSES,
Bechtel Corp., San Francisco, CA.
For primary bibliographic entry see Field 3A.
W88-00711

ECONOMICS OF THE APPLICATION OF MEMBRANE PROCESSES; PART 2, WASTEWATER TREATMENT,
Bechtel Corp., San Francisco, CA.
A. N. Rogers.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 509-546, 28 fig, 1 tab, 10 ref.

Descriptors: *Membrane processes, *Membranes, Hyperfiltration, Ultrafiltration, Pretreatment, Economic aspects, Water treatment, Desalination.

The cost of treating an aqueous waste stream is the sum of pretreatment, membrane plant, and post treatment costs. For each of these cost components, adjustments must be made to account for feed composition, required concentrate concentration, and the target purity of the recovered water. Finally, an allowance must be included to cover the ultimate disposal of the concentrated waste stream if the concentrate is not recovered for sale or reuse. These conclusions are drawn from a detailed discussion of a variety of factors affecting the economics of the membrane process. (See also W88-00700) (Halterman-PTT)
W88-00713

PHOTOLYTIC OZONATION FOR PROTECTION AND REHABILITATION OF GROUNDWATER RESOURCES; A MECHANISTICS STUDY,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
G. R. Peyton, M. A. Smith, and B. M. Peyton.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-214953/AS. Price codes: A04 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana, UILU-WRC-87-206, WRC Research Report No. 206, January 1987. 58 p, 18 fig, 5 tab, 46 ref. State Project No. S-104-ILL.

Descriptors: *Wastewater treatment, *Photolytic ozonation, *Photolysis, *Ozonation, Ozone, Groundwater, Hydrogen peroxide, Oxidation, Hydroxyl radical, Water treatment.

The cleanup of groundwater resources which have been contaminated by anthropogenic organic compounds is difficult and expensive. Most treatment methods merely transfer the contaminant to another phase, such as an adsorbent or the atmosphere. A treatment process which produces harmless by-products, could be set up on-site, and does not require the transport of hazardous materials is very desirable for such cleanup operations. Photolytic ozonation, the combination of ozone treatment and ultraviolet irradiation, is an oxidative water treatment process which is capable of converting almost any organic pollutant completely to carbon dioxide and water. It is potentially a very 'clean' solution to many contamination problems. There has been disagreement in the scientific literature concerning the effectiveness of the process, due largely to a lack of understanding of the chemistry which is involved. Photolytic ozonation was studied at the laboratory scale, to understand and, if possible, model the complex chemical reaction mechanism, so the process can be more economically optimized. Hydroxyl radical, the active species responsible for the destruction of organic pollutants, is not generated directly by ozone photolysis as has generally been speculated, but is produced by secondary reactions. A model has been developed which explains the process under a variety of conditions and is useful for the prediction of process performance. The model includes parameters, the values of which may be inferred from the chemical structure of the organic pollutant. The reaction system is 'versatile' in that it has alternate pathways by which pollutant destruction may proceed, depending on conditions in the water being treated. (Stout-IL WRC)
W88-00727

FORMATION OF TOXAPHENE-LIKE CONTAMINANTS DURING SIMULATED PAPER PULP BLEACHING,
Illinois Univ. at Urbana-Champaign. Environmental Research Labs.
R. A. Larson, and K. A. Marley.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-214946/AS. Price codes: A03 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana, UILU-WRC-86-205, WRC Research Report No. 205, September 1986. 23 p, 5 fig, 1 tab, 35 ref. State Project No. S-100-Ill.

Descriptors: *Wastewater treatment, *Industrial wastes, *Toxaphene, *Chlorination, *Pulp bleaching, Water pollution sources, Monoterpenes, Paper mills, Polychlorinated terpenes.

Toxaphene is a persistent pesticide which is highly toxic to a broad range of organisms including freshwater fish. The sources of toxaphene are still not clearly understood. Atmospheric transport from the cotton-growing districts of the southeastern United States is presently considered the most plausible hypothesis. This mechanism does not adequately explain all of the data on Toxaphene concentrations in different geographical regions of the U.S. In particular, concentrations in the immediate vicinity of the Great Lakes have been increasing, whereas decreases have been observed at Midwestern sites near these lakes. It is conceivable that environmental chlorination reactions, not involving the manufacture or application of Toxaphene at all, may be generating materials closely related to or indistinguishable from Toxaphene. The objective of this research was to simulate pulp bleaching conditions in the laboratory and determine if Toxaphene-like materials could be produced. The aqueous chlorination of the monoterpenes, camphene, limonene, alpha-pinene, and beta-pinene produced complex polychlorinated product mixtures. The extent of chlorination was primarily dependent on pH and light conditions. It is concluded that Toxaphene-like mixtures may conceivably be formed under environmental conditions, but the actual extent of formation of such mixtures and the degree to which they may contribute to apparent Toxaphene in natural samples remain to be assessed. (Stout-IL WRC)
W88-00728

LAND APPLICATION OF SEWAGE EFFLUENT FOR MISSOURI WATER RESOURCES CONSERVATION AND POLLUTION CONTROL,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
J. C. Huang, S. Y. Chang, S. L. Liaw, and S. E. Lakinger.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205746/AS. Price codes: A03 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, Columbia. Completion Report (September 1984). 42 p, 12 fig, tab.

Descriptors: *Land application, *Land disposal, *Wastewater irrigation, Effluent disposal, Groundwater quality, Sewage lagoon treatment, Surface water quality.

A proposed land application site was studied to compare the existing qualities of surface and subsurface waters with estimated effects of disposal. From the 1-year extensive monitoring of the stream water qualities at the eight sampling stations along the Big Piney River, Missouri, it has been established that the lagoon effluent at Cabool has caused a considerable degree of water quality degradation downstream of the present discharge to the stream. Major types of pollutants from the lagoon effluent discharge include organic matter (such as COD), suspended solids, inorganic nutrients (N and P) and coliform bacteria. These data are the major baseline for future assessment of the water quality improvement as a result of land application. Besides the study of surface water, groundwater quality has also been evaluated. In general, the groundwater depth at the application site is very shallow, varying from 4 to 7 feet. Water quality is highly dependent upon natural precipitation. During dry periods, water qualities appear to be superior to those of the wet-weather days. This is presumably caused by the rapid percolation of ground-surface pollutants into the subsurface water. Future application rate of the lagoon effluent needs to be rigidly controlled to eliminate migration of the pollutants to groundwater. (USGS)
W88-00732

INCINERATION OF WATER POLLUTANTS WITH ACTIVATED CHAR FROM COAL, WOOD, OR CROP RESIDUES IN A SYSTEM DESIGNED TO PRODUCE ENERGY AND PYROLYSIS BYPRODUCT CHEMICALS,
Missouri Univ.-Columbia. Dept. of Chemistry.
S. E. Manahan, R. W. Gale, F. C. Laquer, K. E. Smith, and D. J. Bornhops.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201067/AS. Price codes: A02 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, Columbia. Final Technical Completion Report, November 18, 1982. 14 p, 6 fig, 3 tab, 6 ref. Contract No. 14-34-0001-1127. Project No. OWRT A-125-MO (1).

Descriptors: *Wastewater treatment, *Activated carbon, *Chemical wastewater, *Organic compounds, *Incineration, Leachates, Coal gasification.

A wastewater treatment system, particularly useful for treating chemical leachates, was developed on a laboratory scale. Subbituminous coal, 20-60-mesh, was pyrolzyed. A synthetic wastewater containing 3520 ppm total organic carbon was contacted with nonactivated char, char activated in water-saturated nitrogen at 850 C, and coal ash. During a contact time of 0.5 hr, organic removals from the wastewater were 13.3% by nonactivated char, 38.8% by activated char, and 46.5% by ash. For a contact time of 72 hr, organic removals were about 25% for nonactivated char, 58.8% for activated char, and 53.4% for ash. This treatment system is applicable where large amounts of waste carbonaceous material (coal, wood, crop residues) are available. The spent char can be incinerated. Heat from incineration can be used in the pyrolysis step, and the coal ash can be recycled to the water purification step. (Cassar-PTT)
W88-00733

FINANCING WATER SUPPLY AND WASTEWATER SERVICES IN NORTH CAROLINA IN THE 1980S,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
D. H. Moreau, and D. Whittington.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207064/AS. Price codes: A05 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute Completion Report No. 212, February, 1984. 75 p, 14 fig, 10 tab, 28 ref.

Descriptors: *North Carolina, *Costs, *Financing, *Economic aspects, *Water treatment facilities, *Wastewater facilities, *Water rates, *Construction costs, Planning, Economic evaluation, Budgeting, Sewer rates.

This study takes a prospective look at the effects of recent changes in costs and intergovernmental grants on the prices for water and sewer services in North Carolina cities in the 1980s. Results of a survey of 41 of the largest cities in the state are used to estimate the present levels of revenues and expenditures. That survey is also used to identify the major components of revenues and expenditures, and trends in those components are estimated from time series data on relevant indicators. Trends for each of those components are then projected to assess probable revenue and price increases over the next several years. Actions that can be taken by local governments to offset cost increases and grant reductions are evaluated in the context of two case studies, one being the provision of a new source of water for the City of Durham, and the second being an evaluation of the capital improvement program for the Orange Water and sewer Authority (OWASA). A cash flow model for financial planning of water and sewer services is formulated and applied to the evaluation of alternatives for OWASA. (Kiger-UNC-WRRI)
W88-00735

PROCESS FOR STORING LIQUID WASTE IN SALT CAVITIES,
Wintershall A.G., Kassel (Germany, F.R.).
For primary bibliographic entry see Field 5E.
W88-00753

PROCESS FOR TERMINAL STORAGE OF PUMPABLE WASTES,
Wintershall A.G., Kassel (Germany, F.R.).
For primary bibliographic entry see Field 5E.

W88-00761

PROCESS FOR THE BIOLOGICAL DEGRADATION OF HAZARDOUS WASTE BY-PRODUCTS,
J. D. Bogart, and C. W. Hawk.
U.S. Patent No. 4,584,102; April 22, 1986. 5 p, 2 fig, 2 tab. Official Gazette of the United States Patent Office, Vol 1065, No 4, 1850, April 22, 1986.

Descriptors: *Patents, *Wastewater treatment, *Biodegradation, *Industrial wastes, *Hazardous materials, *Biological wastewater treatment, *Wood wastes, *Sludge digestion, Wastewater lagoons, Reservoirs, Nutrients, Emulsifiers, Aeration, Pulp wastes, Metal-finishing wastes, Oil wastes, Pesticides.

Hazardous waste by-products be pressure wood treating plants and other industries are degraded by constructing a treatment unit in a portion of a lagoon or impoundment in which wastewater and sludge are stored, pumping clean water into the treatment unit, adding the sludge, adding a mixture of mutant bacteria, nutrients, and emulsifiers, continuously aerating the mixture, and analyzing samples at regular intervals until the wastewater and sludge are substantially free of detectable hazardous constituents. The process can be used in any industry which utilizes lagoons or impoundments as a method for storing organic biodegradable hazardous waste streams, such as paper and pulp industries, metal plating industries, petroleum industries and pesticides plants. (Cremmins-AEPCO)
W88-00762

METHOD OF DISPOSAL OR TEMPORARY STORAGE OF WASTE MATERIAL,
Preussag A.G. Metall, Goslar (Germany, F.R.).
For primary bibliographic entry see Field 5E.
W88-00763

METHOD AND APPARATUS FOR REMOVING CONTAMINANTS FROM SOIL,
Foster Wheeler Energy Corp., Livingston, NJ.
For primary bibliographic entry see Field 5E.
W88-00766

OXIDATION OF FORMALDEHYDE SOLUTIONS USED FOR THE PRESERVATION OF REVERSE OSMOSIS MEMBRANES,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 3A.
W88-00776

IMPROVED BIOLOGICAL TREATMENT WITH A SECONDARY FLOTATION CLARIFIER,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, D. Guss, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-154196. Price codes: A04 in paper copy, A01 in microfiche. Civil Engineering for Practicing and Design Engineers, Vol. 2, p 307-324, 1983. 4 fig, 1 tab. Contract No. R69P04.

Descriptors: *Biological treatment, *Dissolved air flotation, *Wastewater treatment, Activated sludge, Secondary flotation, Petroleum refining industry, Paper and pulp industry, Municipalities, Sludge rising, Sludge bulking, Dissolved oxygen, Pilot plant investigation, Case history, Supracell.

A Dissolved Air Flotation (DAF) Clarifier can be applied in series between the aeration basin and secondary sedimentation in a conventional activated sludge process to separate the living microorganisms before settling. This results in the following improvements: (1) Solids and hydraulic loadings on an overloaded secondary sedimentation are reduced for preventing sludge rising, increasing clarification efficiency, and saving construction cost on expansion of secondary sedimentation facilities; (2) Hydraulic loading on an aeration basin is reduced thus increasing retention time without increasing aeration basin size; (3) Higher solids content of the wasted sludge represents cost saving and improved operation of sludge thickening, dewatering and disposal; (4) The return sludge, separated by DAF stay in aerobic conditions at all times and are more active than comparable settled activated sludges. The oxygen requirement for the mixed liquor suspended solids is also reduced due to recycling or aerobic sludges, and (5) The problems of sludge rising and sludge bulking can be totally solved when using DAF. Pilot scale results and full scale design considerations are presented. (USGS)
W88-00805

DEVELOPMENT OF A NEW TREATMENT SYSTEM CONSISTING OF ADSORPTION FLOTATION AND FILTRATION,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, L. K. Wang, and M. Boutroy.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-209401/AS. Price codes: A03 in paper copy, A01 in microfiche. Lenox Institute for Research Inc., Lenox, MA. Technical Reports No. LIR/10-84/7, Oct. 1984. 28 p, 2 tab, 3 app. Project No. R83P04.

Descriptors: *Flotation, *Filtration, *Wastewater treatment, Innovation, Adsorption, Powdered activated carbon, Dissolved air flotation, Water treatment.

Powdered activated carbons are widely used in treatment of water and wastewater. This paper introduces a new Sandfloat system consisting of powdered carbon adsorption, chemical flocculation, dissolved air flotation and sand filtration. Powdered carbons initially are dosed as adsorbents for taste and odor control, and for removal of color and any other unwanted impurities from water or wastewater. Subsequently the spent suspended carbons are flocculated by coagulants, and floated to the water surface by dissolved air flotation. Finally the flotation clarified water is polished by sand filtration. A continuous pilot plant was operated at 34.065 L/min (9 gal/min) for purification of pretreated water containing 249.67 mg/L of powdered activated carbon. Nearly 100% of powdered carbon was removed when 1.498 mg/L of anionic polymer and 2.4967 mg/L of cationic surfactant were dosed as coagulant and disinfectant, respectively, at neutral pH. All taste, odor, and color in the influent water were removed. Flotation was controlled at 33.3% recycle water flow, and 0.5 SCFH air flow. Sand filter was packed with 27.94 cm (11 inches) of quartz sand (E=0.35 mm, U=1.55). (USGS)
W88-00806

EVALUATION OF PHYSICAL-CHEMICAL AND BIOLOGICAL TREATMENT OF SHALE-OIL RETORT WATER,
Battelle Pacific Northwest Labs., Richland, WA.
B. W. Mercer, M. J. Mason, R. R. Spencer, A. L. Wong, and W. Wakamiya.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-000915. Price codes: A06 in paper copy, A01 in microfiche. PNL-3449, September 1982. 107 p, 25 fig, 26 tab, 39 ref, append. Contract No. DE-AC06-76RLO 1830.

Descriptors: *Wastewater treatment, *Industrial waste, *Oil shale, Biological treatment, Activated sludge, Anaerobic digestion, Activated carbon, Adsorption, Suspended solids, Ammonia, Heavy metals, Metals, Coagulation.

Bench-scale studies were conducted to evaluate conventional physical-chemical and biological treatment processes for removal of pollutants from retort water produced by in situ shale oil recovery methods. Preliminary cost estimates (1980 dollars) for treatment to produce an effluent suitable for cooling towers were $10.78 to $24.75 per 1000 gal (45 cents to $1.04 per barrel of oil produced at a 1:1 ratio of retort water to oil). Evaporation treatment was estimated at $7 per 1000 gal, with some further treatment necessary. Anaerobic digestion proved impractical because of toxicants present in the wastewater. An activated sludge culture was acclimated to the waste using careful pH control (7.0 + or - 0.5 with strong mineral acid) and a long acclimation period. With 300 mg/L powdered activated carbon addition, this removed up to 70% COD, 65% total organic carbon, and 94% thiocyanate. Activated carbon was much more effective in removing dissolved organic matter from biotreated water than from nonbiotreated retort water. It was also effective in removing color, odor, and copper. Steam stripping was used as a pretreatment for reducing ammonia before aerobic biological treatment. Limited tests on removal of suspended matter showed that alum treatment was not successful; cationic polymers were better than either an anionic or neutral polymer. Precipitation scavenging of heavy metals with Fe3+ solutions reduced As from 4.1 to <1 mg/L, Cu by a factor of 2.6, and several other heavy metals (Co, Sb, Se, Mo, and V) by less than a factor of 2. (Cassar-PTT)
W88-00807

BIODEGRADABILITY TESTING OF INDUSTRIAL WASTES AND INTRACTABLE SUBSTANCES,
National Inst. for Water Research, Pretoria (South Africa).
R. J. L. Drews.
CSIR Technical Guide K 57, August 1981. 25 p, 11 fig, 14 ref, append.

Descriptors: *Wastewater treatment, *Industrial wastes, *Biodegradation, *Organic compounds, Pollutant identification, Degradation, Incubation, Activated sludge, Biochemical oxygen demand, Chemical oxygen demand, Acclimatization, Fate of pollutants, Trickling filters, Biological wastewater treatment.

Methods for testing the biodegradability of organic wastes are reviewed and compared in the laboratory. Incubation-type tests include BOD tests filled and closed bottles, shake flask test using a closed vessel, open flask (also known as the river dieaway test or Mason jar test, often used with surface active agents) open vessel incubation, and respirometry. Laboratory plant-scale methods are divided into acclimatized activated sludge methods (fill and draw methods and continuous feed completely mixed method) and biological bed methods (trickling filter and rotary tube trickling filter). Three methods are described in detail: the batch feed (fill and draw), (2) continuous feed method (completely mixed), and (3) the biofilter (packed column) method. All three methods are considered suitable for biodegradability testing because they require acclimatization, obtain ultimate breakdown of the contaminant, and use COD determination. The character of an individual waste determines which method is most suitable. The batch feed and continuous feed methods may be more suitable than the packed column method for an easily degradable waste. For wastes more difficult to degrade, the packed column method gives more acceptable results. The continuous feed method is the most costly because it requires pumps and timers. (Cassar-PTT)
W88-00835

PILOT STUDIES ON THE TOXICITY OF EFFLUENT FROM CONVENTIONAL AND CARBON ENHANCED TREATMENT OF REFINERY WASTEWATER: PHASE III,
Texaco, Inc., Port Arthur, TX. Port Arthur Research Labs.
R. B. Borey.
American Petroleum Institute, Washington, D.C., Publication No. 985, May 1981. 103 p, 18 fig, 34 tab, 17 ref, 6 append.

Descriptors: *Wastewater treatment, *Oil wastes, *Oil refineries, *Industrial wastewater, *Activated carbon, Biological wastewater treatment, Hydrocarbons, Cadmium, Zinc, Toxicity, Effluents, Pilot plants, Bioassay, Fish, Activated sludge process.

The effluent toxicity of a well-operated pilot-scale activated sludge unit treating a Class D refinery wastewater was assessed and benefits gained through powdered activated carbon enhancement

and add-on granular adsorption technologies were determined. Three pilot-scale activated sludge units were operated in parallel with common pretreatment utilizing wastewater streams from a Class D refinery. Half-strength and full-strength effluents from the pilot units were compared over three separate 30-day test periods using conventional effluent parameters and continuous-flow fish bioassays with sheepshead killifish, Cyprinodon variegatus. Fish bioassays showed that the effluents have low toxicity in both 96-hour and 30 day tests. Fish mortalities during these tests were too low and/or variable in half-strength and full-strength effluents to demonstrate adequately any significant or consistent difference between conventional activated sludge treatment, powdered activated carbon enhanced treatment, and end-of-process granular activated carbon treatment. Activated carbons may contribute some polynuclear aromatic hydrocarbons to treated effluents and may be related to slightly elevated concentration of cadmium and zinc in fish exposed to carbon treated effluents. (Author's abstract)
W88-00879

PROCESS DYNAMICS, CONTROL AND PROTECTION,
For primary bibliographic entry see Field 5F.
W88-00880

TREATMENT TECHNOLOGY FOR REMOVAL OF DISSOLVED GASOLINE COMPONENTS FROM GROUND WATER.
IT Enviroscience, Inc., Knoxville, TN.
Final Report, Vol. 2, D97-API, American Petroleum Institute, May 13, 1983. 27 p, 3 tab, 9 fig, 6 ref.

Descriptors: *Water treatment, *Gasoline, *Methyl t-butyl ether, Air stripping, Activated carbon, Cost Analysis, Organic compounds, Groundwater.

Both activated carbon adsorption and air stripping are options for treating groundwater containing dissolved gasoline components. For low concentration, low volume applications the treatment cost differential between carbon adsorption and air stripping is likely to be low enough that a decision can be based on availability and ease of installation and operation. For high volume, high concentration applications air stripping is less expensive. Carbon adsorption on a stand-alone basis may become more expensive if emission treatment is required in conjunction with the air stripping system. Treatment costs for carbon adsorption with nondestructive regeneration reflect high initial capital investment and low operating costs while treatment costs for air stripping generally reflects the opposite, especially at high air/water ratios. In areas where electrical costs are higher than average, air stripping may lose some of its cost advantage. Air stripping requires a minimum air/water ratio of 15 cfm/gpm to achieve 99.9% removal efficiency for methyl t-butyl ether. The treatment costs are not significantly different over the range of flow rates at an inlet concentration of 10 ppm TOI (total inorganic of interest) for either treatment option. At a flow rate of 200 gpm, air stripping treatment cost is not a function of concentration and stripping gains a cost advantage over carbon adsorption as concentration increases. This conclusion assumes that the treatment goal for an air stripping system is 99.9% removal. If specification of an effluent concentration requires a removal efficiency >99.9%, the treatment cost for air stripping will be a function of concentration. (Author's abstract)
W88-00885

1982 NEEDS SURVEY: COST ESTIMATES FOR CONSTRUCTION OF PUBLICLY-OWNED WASTEWATER TREATMENT FACILITIES.
Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
For primary bibliographic entry see Field 6C.
W88-00917

WATER RECYCLING IN THE FRUIT AND VEGETABLE PROCESSING INDUSTRY,
Montgomery (James M.), Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 6D.
W88-00925

BIOSORPTION/HEAVY METAL IONS FROM INDUSTRIAL/MINING WASTE WATERS,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
D. W. Darnell.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-216503/AS. Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Report No. 210, September 1986. 34 p, 14 fig, 1 tab, 21 ref. State Project No. 1423624.

Descriptors: *Heavy metal ions, *Wastewater treatment, *Algal biomass, *Ion exchange, Algae, Biomass, Water treatment, Industrial wastes, Mining wastes, Hydrogen ion concentration.

The interactions between algal biomass and various metal ions were investigated. For most of the ions examined, uptake is dependent upon pH, with cations bound most strongly above pH 4 and complex anions bound most strongly at lower pH values. However, the binding of gold (III), silver, and mercury (II) ions is relatively insensitive to pH. Heat-treatment of the biomass was found to have little effect on binding capacity. As with other ion-exchange matrices, the extent of metal-ion removal is strongly influenced by the solution composition - in particular, the presence of competing ligands. However, unlike conventional strong-acid cation-exchange resins, the algal biomass displays low affinity for Ca(2+) and Mg(2+) and, thus, may be especially well-suited for hard-water treatment applications. Algal biomass can be readily immobilized in silica to produce a durable chromatographic support which shows substantial longevity in lab-scale operations. (Darnell-NM St. Univ.)
W88-00960

5E. Ultimate Disposal Of Wastes

ANALYSIS OF HYDRAULIC GRADIENTS ACROSS THE HOST ROCK AT THE PROPOSED TEXAS PANHANDLE NUCLEAR-WASTE REPOSITORY SITE,
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 2F.
W88-00017

GEOLOGIC ASPECTS OF HAZARDOUS WASTE SITE INVESTIGATIONS IN MISSOURI,
Missouri Dept. of Natural Resources, Rolla. Div. of Geology and Land Survey.
J. H. Williams, and G. St. Ivany.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 24, No. 1, p 43-51, February 1987. 6 fig, 2 tab, 7 ref.

Descriptors: *Waste disposal sites, *Waste disposal facilities, *Hazardous waste disposal, *Missouri, *Geology, Rocks, Topography, Geological history, Groundwater, Surface water, Groundwater pollution.

The Missouri Department of Natural Resources has developed and applied a philosophy of assessment in the investigation of waste disposal facilities (including hazardous-waste sites) based on degrees of geologic limitations. Limitations were developed using the following factors: surficial-material thickness and properties; bedrock type; topography; geologic history of the landscape; and surfacewater and groundwater relationships. Using these factors, regions in Missouri were assigned geologic limitations of slight, moderate, and severe. The assignment of limitations based on regional geologic factors allows for inclusion of site-specific information and the necessary evaluation of non-geological data before a site decision is made. (Main-PTT)
W88-00074

DIFFERENTIATION OF PHYSICAL FROM CHEMICAL TOXICITY IN SOLID WASTE FISH BIOASSAYS,
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
For primary bibliographic entry see Field 5C.
W88-00098

EFFECTS OF FERTILIZER FACTORY EFFLUENT ON SOIL AND CROP PRODUCTIVITY,
D.A.V. Coll., Muzaffarnagar (India). Dept. of Botany.
For primary bibliographic entry see Field 3C.
W88-00099

COPPER ACTIVITY IN SOIL SOLUTION: II. RELATION TO COPPER ACCUMULATION IN YOUNG SNAPBEANS,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5A.
W88-00105

WATER REUSE.
For primary bibliographic entry see Field 5D.
W88-00164

SEWAGE SLUDGE STABILISATION AND DISINFECTION.
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5D.
W88-00237

SLUDGE DISINFECTION - AN OVERVIEW OF METHODS AND THEIR EFFECTIVENESS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 5D.
W88-00239

STABILISATION AND DISINFECTION - THEIR RELEVANCE TO AGRICULTURAL UTILISATION OF SLUDGE,
Water Research Centre, Stevenage (England).
E. B. Pike, and R. D. Davis.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 61-84, 1 fig, 6 tab, 40 ref.

Descriptors: *Sludge disposal, *Disinfection, *Sludge utilization, *Land application, *Land disposal, Sludge, Composting, Sludge conditioning, Fertilizers, Wastewater treatment, Digested sludge, Nutrients, Nitrogen, Phosphorus, Parasites, Health aspects, Solid waste disposal.

Stabilization of sewage sludge for purposes of land application helps to eliminate certain pathogens while offering readily available N supplies for crops. Where a more complete control of pathogens is required, sludge disinfection should be used. The risk of disease being acquired from sludge applied to agricultural lands from salmonellae and Taenia saginata appears to be minimal in the United Kingdom provided that suitable control measures are followed. Most diseases are controlled by imposing barriers to interrupt the cycles of infection, taking local conditions and results of disease surveillance into account. Stabilization produces sludges with relatively inoffensive odor characteristics. Smell problems can be minimized by sensible management practices and incorporation of the sludge into soil immediately after spreading. Problems of odor control and possible disease transmission are avoided if the sludge is injected beneath the soil surface. Mesophilic anaerobic digestion increases potential toxic element concentrations in raw sludge by about 50%, but less digested sludge than raw sludge is needed to meet N requirements of crops. Liquid digested sludge is the most valuable sludge for providing readily available sources of N. Stabilization has little effect on the availability to crops of P in sludge. Lime treatment of sludge does not reduce P availability. Organic matter in dewatered digested and compost is an effective plant nutrient and

soil conditioner. (See also W88-00237) (Geiger-PTT)
W88-00240

AUTOMATION AND UPRATING OF ANAEROBIC DIGESTERS,
Anglian Water Authority, Norwich (England). Norwich Sewage Div.
For primary bibliographic entry see Field 5D.
W88-00243

EXPERIENCES WITH THE PRE-PASTEURIZATION OF SEWAGE SLUDGE WITH HEAT RECOVERY,
Huber Enviro Consult A.G., Belp (Switzerland).
J. Huber, and E. Mihalyfy.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd.,.Chichester, England, 1984. p 381-398, 12 fig, 10 ref.

Descriptors: *Sludge utilization, *Sludge disposal, *Pasteurization, *Heat treatment, *Sewage sludge, Anaerobic digestion, Land application, Disinfection, Sludge solids, Land disposal, Wastewater treatment, Sludge thickening, Dewatering, Sludge drying, Sludge digestion, Digestion.

The process of pre-pasteurization of liquid sewage sludge before digestion for application of sludge to agricultural lands has been tested successfully in Switzerland. Processes involving heat recovery are more usual, although there are some facilities such as the Belp Sewage Treatment Plant, that employ reductions in the volume of raw sludge before pasteurization. Volume reduction can be accomplished with a filter-drum, centrifuge or by flotation thickening, of either a mixture of primary and secondary sludge, or only secondary sludge. For breakdown-free operation of the pre-pasteurization process, a suitable pretreatment of raw sludge by macerating or sieving is indispensable. The heat requirements with good energy recovery are of the same order as those required for conventional anaerobic stabilization. Under Swiss conditions, a plant with a raw sludge throughput of 10 to 80,000 cu m/yr, costs are on the order of 1 to 4.5 Francs/cu m for capital costs, and 0.4 to 1.3 Francs/cu m for operating costs. (See also W88-00237) (Geiger-PTT)
W88-00257

EFFECTIVENESS OF CHEMICAL DISINFECTION ON PARASITES IN SLUDGE,
Liverpool School of Tropical Medicine (England).
For primary bibliographic entry see Field 5D.
W88-00260

EFFECT OF LIME TREATMENT OF SEWAGE SLUDGE ON THE HATCHING AND VIABILITY OF HUMAN BEEF TAPEWORM,
Welsh Water Authority, Powys.
For primary bibliographic entry see Field 5D.
W88-00261

ACCEPTABLE ALTERNATIVE: LIME STABILISATION OF SEWAGE SLUDGE AND DISPOSAL TO AGRICULTURAL LAND,
North West Water Authority, Bootle (England).
F. Beaumont.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 529-540, 1 fig, 14 ref.

Descriptors: *Lime, *Sludge disposal, *Land application, *Land disposal, *Waste disposal, Sludge conditioning, Sludge drying, Dewatering, Nutrients, Hydrogen ion concentration, Cost analysis, Sewage sludge, Sludge, Digested sludge.

The decision was made to lime stabilize the sludge of the Ellesmere Port Works and to dispose of the treated sludge to agricultural lands. The sludge and lime is thoroughly mixed in the conditioning tank by a motor-driven fixed-bridge stirrer. After 24 hr in the holding tank, the sludge is consolidated and screened twice before land disposal. The lime stabilization and land disposal operation is more economical than the previous method used. The present operating costs for the treatment of the sludge by lime stabilization are 15.41 lbs/dry ton and the operating costs of disposal are 32.78 lbs/dry ton. There have been no serious problems with blockages when rain guns are used for application. On the average, the quantity of sludge removed to land is 175 cu m/day for five and a half days/week at a dry solids content of 6.80%. A system of control and recording was devised using a card identifying each individual field to be utilized and analyzing the sludge to be inserted. The lime present in the sludge renders most metals less available to the crops concerned and offers important nutrients since the removal of the Government subsidy on lime. (See also W88-00237) (Geiger-PTT)
W88-00267

LIME STABILISATION OF UNDIGESTED SEWAGE SLUDGE,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5D.
W88-00268

REVIEW OF SEWAGE SLUDGE TREATMENT AND DISPOSAL IN EUROPE,
Water Research Centre, Stevenage (England).
A. J. Vincent, and R. F. Critchley.
IN: Sewage Sludge Stabilisation and Disinfection. Ellis Horwood Ltd., Chichester, England, 1984. p 550-571, 3 fig, 5 tab, 25 ref, 4 append.

Descriptors: *Reviews, *Sewage sludge, *Sludge disposal, *Sludge conditioning, *Europe, Digested sludge, Sludge drying, Dewatering, Anaerobic digestion, Landfills, Land disposal, Ocean dumping, Sludge thickening, Water disposal, Incineration, Solid waste disposal, Wastewater treatment.

Currently, 6.5 million tons of dry sludge solids (tds)/yr are produced in the 16 countries of the European Economic Community (United Kingdom, Belgium, Denmark, France, Federal Republic of Germany, Greece, Republic of Ireland, Italy, Luxembourg, Netherlands, Austria, Finland, Norway, Spain, Sweden, and Switzerland). Many countries are rapidly developing their sewage and sludge treatment capabilities, and so a further 2.5 million tds/yr will be produced by 1990. At present, 70% of the sludge receives some form of stabilization. Anaerobic digestion is the most popular method of sludge stabilization. About 75% of the sludge is dewatered, although in several countries the proportion is over 90%. This reflects the high degree of the use of landfill sites for disposal in many countries. Drying beds, filter plate pressing, filter belt pressing, and centrifuging are all popular dewatering methods. Forty-three percent of the sludge produced in Europe is disposed of at landfill sites or used in reclamation of derelict land, 37% is used in agriculture, 8% is incinerated, 7% is disposed of at sea and, using the data currently available, 5% is unaccounted for. The United Kingdom is the only major user of sea disposal. (See also W88-00237) (Geiger-PTT)
W88-00269

RESEARCH NEEDS RELATED TO MUNICIPAL WASTEWATER RENOVATION AND REUSE IN ARID AND SEMIARID AREAS,
New Mexico Water Resources Research Inst., Las Cruces.
For primary bibliographic entry see Field 3C.
W88-00289

RESEARCH NEEDS IN MEXICO WITH RESPECT TO THE RENOVATION AND REUSE OF DOMESTIC WASTEWATER,
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
For primary bibliographic entry see Field 3C.
W88-00290

SLUDGE TREATMENT AND DISPOSAL,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
IN: Environmental Pollution and Control, 2nd edition. Butterworth, Boston, MA. 1983. p 113-128, 9 fig, 1 tab.

Descriptors: *Sludge disposal, *Sludge treatment, *Land disposal, Sludge drying, Dewatering, Sludge thickening, Sludge digestion, Primary sludge, Activated sludge, Liquid sludge, Anaerobic digestion, Digestion, Filters.

Sludge is produced in both primary and secondary wastewater treatment processes. Treatment is needed because the sludge is esthetically displeasing, is potentially harmful, and contains too much water. Sludge stabilization reduces odor and the level of pathogens by several techniques: lime, aerobic digestion, and the most commonly used, anaerobic digestion. Sludge thickening (sludge still behaves as a liquid) can be accomplished by gravity or flotation. Sludge dewatering (sludge behaves as a solid) is done by sand beds, vacuum filters, pressure filters, belt filters, and centrifuges. Ultimate disposal of sludge is by air (incineration), water (ocean dumping), or land. The best type of soil for successful sludge disposal is sandy, with lush vegetation, low rainfall and gentle slopes. Chemical fixation before disposal of industrial sludge minimizes leaching from the disposed material. (See also W88-00314) (Cassar-PTT)
W88-00335

INACTIVATION OF PARASITE-CONTAMINATED DOMESTIC WASTEWATER SLUDGES,
Lubbock Christian Coll., TX. Inst. of Water Research.
For primary bibliographic entry see Field 5D.
W88-00462

CHARACTERIZATION OF CLIMAX GRANITE GROUND WATER,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 2K.
W88-00481

PERVIOUS SURROUND METHOD OF WASTE DISPOSAL,
M. A. J. Matich, and W. F. Tao.
U.S. Patent No. 4,580,925; April 8, 1986. 10 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1065, No 2, p 742-743, April 8, 1986.

Descriptors: *Patents, *Underground waste disposal, *Disposal wells, *Groundwater pollution, *Water pollution control, *Pervious soils, Filtration, Seepage control, Groundwater movement, Containment.

A pervious envelope isolates deposited waste materials from surrounding groundwater. The system has utility in long term disposal of wastes, such as mine tailings (including uranium tailings), industrial wastes, sanitary landfills and similar solid wastes. It can also be adapted for disposal of high-level radioactive and liquid chemical wastes to enhance the containment capability. A cavity is provided in the ground below the level of the groundwater table. A continuous pervious zone of natural, durable material is disposed about the interior of the cavity. A filter zone of this material, having a grain size and gradation common to conventional graded filter materials, is disposed within the pervious zone. A waste disposal zone is provided within the filter zone. A cover is placed over the cavity by continuing the filter and pervious zones over the cavity beneath the level of the groundwater table, so that the level reinstates over the deposited wastes. (Cremmins-AEPCO)
W88-00497

DRAINAGE SYSTEM,
J. J. Milly.
U.S. Patent No. 4,589,798; May 20, 1986. 5 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1066, No 3, p 1282, May 20, 1986.

Descriptors: *Patents, *Drainage water, *Disposal wells, *Pipes, *Drainage ditches, *Lawns, Subsoil

drains, Drainage engineering, Storm runoff, Water distribution.

Water drained off a building is dispersed through a drainage pipe to an enclosure below a lawn surface in water permeable material. An opening in a side wall of the enclosure extends upward to essentially terrain level. The enclosure is covered by a top plate which is vertically and laterally supported on the side walls. Water supplied to the enclosure through the down pipe rises up through openings in or around the top cover. The open region is distributed so that the volume of water reaching any point around the enclosure is relatively small. The area of this open region is greater than the area of the down spout, thus reducing the velocity of the water. (Cremmins-AEPCO)
W88-00498

METHOD AND RESERVOIRS FOR IN-GROUND CONTAINMENT OF LIQUID WASTE,
PPG Industries, Inc., Pittsburgh, PA.
D. D. Metzger, and J. E. Merriman.
U.S. Patent No. 4,592,846; June 3, 1986. 5 p. Official Gazette of the United States Patent Office, Vol 1067, No 1, p 269-270, June 3, 1986.

Descriptors: *Reservoirs, *Liquid wastes, *Patents, *Petroleum products, *Waste storage, *Containment, Pollutants, Reservoir construction, Reservoir design, Drainage area, Drains, Linings, Drilling, Impervious membranes, Liner caps.

An in-ground reservoir for the containment of liquid-containing waste materials is particularly applicable for the containment of drill cuttings, drilling mud residues, brine and other fluids produced during development of petroleum. The containment reservoir minimizes the possibility of ground and/or water pollution by fluids expelled from an earthen pit as a result of backfilling the pit with soil. The reservoir includes a drain area for fluid waste material excluded from the reservoir, a liquid passageway from the reservoir to the drain area, and means for accessing fluid accumulating in the drain area. The reservoir and drainage area are covered with a flexible liquid-impervious liner cap. The space above the reservoir and drainage area is filled with soil to the final grade of the surrounding terrain. (Cremmins-AEPCO)
W88-00505

METHOD FOR STABILIZATION OF SLUDGE,
Velsicol Chemical Corp., Chicago, IL.
For primary bibliographic entry see Field 5D.
W88-00506

CONTROLLED GEL TIME FOR SOLIDIFICATION OF MULTI-PHASED WASTES,
Chem-Technics, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5D.
W88-00508

MOISTURE IMPERVIENT BARRIER AND METHOD FOR MAKING SAME,
For primary bibliographic entry see Field 5G.
W88-00509

UNDERGROUND LEACHATE BARRIER AND METHOD OF MAKING SAME,
G. R. Tallard.
U.S. Patent No. 4,543,016; September 24, 1985. 5 p, 6 fig, 2 tab. Official Gazette of the United States Patent Office, Vol 1058, No 4, p 1055, September 24, 1985.

Descriptors: *Patents, *Underground structures, *Landfills, *Waste disposal, *Leachates, *Water pollution control, *Disposal, Leaching, Trenches, Impervious membranes, Slurries, Drainage systems, Biodegradation, Water pollution prevention.

An underground barrier to prevent leachate from escaping a contaminated disposal area and to collect the leachate for above ground disposal is described. The barrier includes a trench excavated under the biodegradable slurry adjacent to a contaminated site and contains a liquid impervious membrane placed along a wall of the trench. The membrane is sealed along the length of its lower edge by an impervious plug formed on the bottom of the trench. After a drain pipe with monitoring risers is positioned in the slurry, the trench and slurry are back filled with filter gravel. The resultant barrier stops possible migration of the leachate out of the boundaries of the site and enables leachate entering the porous filter gravel and fermented biodegradable slurry mixtures to be collected in the drain pipe and pumped out through a riser pipe or at a low point pumping station for safe above-ground treatment and disposal. This underground barrier can be excavated by workmen above ground by digging under a biodegradable slurry, thereby minimizing their exposure to hazardous contaminants and also minimizing the volume of excavated material which must be hauled away and disposed at an approved site. (Cremmins-AEPCO)
W88-00514

FLUID TRANSPORT AND PROCESSING SYSTEM,
For primary bibliographic entry see Field 5G.
W88-00528

WASTE EFFLUENT TREATMENT AND SOLVENT RECOVERY SYSTEM,
For primary bibliographic entry see Field 5D.
W88-00580

METHOD AND APPARATUS FOR PRE-DILUTION OF DRILLING MUD AND SLURRY AND THE LIKE,
Atlantic Richfield Co., Los Angeles, CA.
For primary bibliographic entry see Field 5D.
W88-00588

SYSTEM FOR DETECTING LEAKS FROM LIQUID-CONTAINING RESERVOIRS AND CONDUITS,
V. R. Johnson.
U.S. Patent No. 4,404,516; September 13, 1983. 7 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1034, No 2, p 804, September 13, 1983.

Descriptors: *Patents, *Leakage, *Chemical wastes, *Waste storage, *Electrical equipment, Storage reservoirs, Conduits, Water tanks, Settling basins, Ponds, Pipelines, Electrical properties, Hazardous materials.

An electrically conductive wire network detects and locates leaks from chemical-containing reservoirs, settling basins, storage basins and tanks, solar ponds, holding areas for waste streams, and pipelines and other conduit systems. When a leak occurs, chemicals corrode the wires or degrade the insulation around them. Changes in the electrical properties of each wire affected allow the leak to be detected and localized in two dimensions. (Cremmins-AEPCO)
W88-00601

SUBSURFACE WASTE DISPOSAL SYSTEM,
Genstar Waste Transfer, Inc., San Mateo, CA.
S. W. Maphis.
U.S. Patent No. 4,448,690; May 15, 1984. 10 p, 7 fig, 2 tab. Official Gazette of the United States Patent Office, Vol 1042, No 3, p 1178, May 15, 1984.

Descriptors: *Patents, *Underground waste disposal, *Wastewater treatment, *Sludge disposal, *Subsurface drainage, *Injection, Sludge bed, Groundwater pollution, Perched water table, Drainage systems.

An artificial perched bed of layered granular soil receives sludge and other wastes in a semi-liquid form, retains the solids from the wastes within the bed, and allows the liquid portion of the wastes to percolate through the bed into an underdrain system for removal. An aerobic upper layer of the bed is formed from relatively fine grained material, and a lower layer is formed from relatively coarser grained material. The underdrain system is located in the lower layer which may be separated from the upper layer to permit the passage of liquid to the lower layer while maintaining the solids in the upper layer. The underdrain system carries the collected liquid to a collection basin for monitoring, discharge, or return to the bed for further treatment. An impervious liner under the perched bed prevents seepage of effluent from the bed into the natural underlying ground and water table. A subsurface sludge injector operates to permit intensive use of the bed. The injector maintains a soil covering over the sludge, thereby eliminating problems of odors, vector control, surface runoff, and unsightliness. The deflector nozzle meters the flow of the waste into a subsurface cavity that is continuously formed by the moving injector, thus providing even distribution of the waste material into the soil media. (Cremmins-AEPCO)
W88-00603

METHOD FOR THE ULTIMATE DISPOSAL OF HIGH LEVEL RADIOACTIVE WASTE,
Chevron Research Co., San Francisco, CA.
J. R. B. Ellis, and B. A. Fries.
U.S. Patent No. 4,400,314; August 23, 1983. 5 p, 1 fig, 5 ref. Official Gazette of the United States Patent Office, Vol 1033, No 4, p 1558-1559, August 23, 1983.

Descriptors: *Patents, *Underground waste disposal, *Dilution, *Radioactive waste disposal, *Waste treatment, *Wastewater disposal, Confined-water wells, Geologic formations, Injection wells, Radioactive wastes, Offshore platforms.

Aqueous solutions of radioactive nuclides are disposed by producing water from a porous, generally horizontally-extending, water-permeable geological formation located below sorptive sedimentary geological strata; forming a dilute solution of the radioactive nuclides by mixing produced water with the aqueous solution; and injecting the dilute solution into the geological formation. Preferably, the geological formation selected to provide both water for dilution and an injection site for confining the dilute solution is located in a subsea area. Offshore disposal in a subsea geological formation substantially assures that the disposed nuclides will not enter an aquifer from which water is withdrawn for surface use or from which there is a natural flow to on-shore, surface locations. Offshore geological disposal also ensures that any nuclides which migrate out of the formation used for disposal will be immediately further highly diluted by ocean water. (Cremmins-AEPCO)
W88-00604

PROCESS FOR CONTAINMENT OF LIQUIDS AS SOLIDS OR SEMISOLIDS,
Agritec, Inc., Houston, TX.
R. L. Durham, C. R. Henderson, and R. C. Allison.
U.S. Patent No. 4,460,292; July 17, 1984. 7 p, 3 tab. Official Gazette of the United States Patent Office, Vol 1044, No 3, p 1156, July 17, 1984.

Descriptors: *Patents, *Liquid wastes, *Waste disposal, *Wastewater treatment, *Silica, Waste management, Drilling, Mud, Solvents, Oils, Pesticides, Solid wastes.

Liquid wastes, drilling mud, chemicals, and solvents are confined by adding directly to these liquids biogenetic silica in an amorphous state with a porous skeletal structure, either alone or with additives, in an amount sufficient to hold the liquid in the form of a solid or semi-solid. The biogenetic silica can be applied to the surface of the liquid, either in bulk or in pellets. For very heavy or viscous liquids, some stirring may be necessary and preferably the amount added should be sufficient so that there is no free-standing liquid. The liquid can then be removed, handled, transported, or disposed as a solid or a semi-solid. The preferred biogenetic silica source is rice hull ash. Other useful sources are ash from the cell structure of rice stalks, equistem (horsetail weeds), and certain palm leaves, particularly palmyra pollen. (Cremmins-AEPCO)

W88-00613

WATERPROOFING SOIL,
Clem Environmental Corp., Chicago, IL.
For primary bibliographic entry see Field 5G.
W88-00614

GROUNDWATER PROTECTION SYSTEM,
Environmental Design, Inc., Palm Beach, FL.
For primary bibliographic entry see Field 5G.
W88-00615

PROCESS AND STRUCTURE FOR STORING AND ISOLATING HAZARDOUS WASTE,
Rollins Environmental Services, Inc., Wilmington, DE.
E. Hillier, L. Graybill, R. Winders, D. Bridge, and J. Dauchy.
U.S. Patent No. 4,464,081; August 7, 1984. 13 p, 6 fig, 3 tab. Official Gazette of the United States Patent Office, Vol 1045, No 1, p 226, August 7, 1984.

Descriptors: *Patents, *Waste storage, *Hazardous materials, *Water pollution prevention, *Monitoring, *Waste disposal, Impervious membranes, Barriers, Water pollution control, Leaching, Liners, Surface water, Groundwater pollution.

Hazardous wastes are sorted or disposed above ground in a structure that isolates the wastes, particularly from surfaces and groundwater. The structure contains a first protective layer for surrounding the hazardous waste and a liner around this layer, which is relatively impervious to water and leachates that the hazardous waste might produce. A second protective layer provides pervious infiltration around the sides and top of the liner to permit gravitational flow and run off of any fluid that might enter the pervious infiltration layer. A perimeter support wall about the periphery of the second protective layer holds in place the layers, liner, and hazardous waste and thereby minimizes any horizontal slippage of the waste. A cap over the second protective layer protects the hazardous waste from the surface environment. A monitoring system provides for the gravitational flow and run off of any water and leachates on the cap, in the liner, or in the first or second protective layers. (Cremmins-AEPCO)
W88-00616

MOBILE SLUDGE HANDLING APPARATUS,
Feluwa, Schlesiger and Co. K.G. Muerlenbach (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W88-00617

FLUID WASTE DISPOSAL,
Gassett (John D.), Tulsa, OK.
J. S. Bradley.
U.S. Patent No. 4,560,503; December 24, 1985. 1 fig, 3 tab. Official Gazette of the United States Patent Office, Vol 1061, No 4, p 1663, December 24, 1985.

Descriptors: *Patents, *Underground waste disposal, *Radioactive water disposal, *Liquid wastes, *Reservoirs, *Hydrostatic pressure, Sealants, Toxicity, Industrial wastes, Gravity flow, Mathematical models.

Toxic or radioactive liquid waste is disposed in porous, permeable, sub-surface strata which, before any fluid has been removed therefrom, has fluid pressure in the pores that is less than normal hydrostatic pressure of the water for that depth of strata in that area. The industrial fluid waste is then flowed by gravity into such sealed underpressure reservoirs at a rate so that the fluid pressure never exceeds the normal hydrostatic pressure. The underpressure reservoirs can be filled with liquid waste until they approach normal pressure without disturbing the seal or displacing any fluids outside the seal. (Cremmins-AEPCO)
W88-00621

PROBLEMS WITH METALS IN THE RESIDUE FROM COMBINED MUNICIPAL/INDUSTRIAL WASTE TREATMENT,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
H. M. Jeffus.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-142463. Price codes: A24 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Tx. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 544-550, 3 tab, 4 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Municipal wastewater, Pollutants, Heavy metals, Water treatment facilities, Wastewater facilities, Sludge, Toxicity, Land disposal.

Metals occur in the wastewater from many industrial processes. There are also some notable examples of metals in wastewater from municipal residential areas. These metals tend to concentrate in the residue from water treatment. The disposal of this residue requires careful planning and monitoring if adverse consequences are to be avoided later. Metals limit biological treatment and disposal alternatives. Alternatives for disposal are: burial, landspreading, incineration, and encapsulation with subsequent burial. Burial imposes a potential problem of contamination of groundwater. Careful consideration must be given to potentially hazardous metals that become more mobile in a reducing environment. Landspreading imposes the potential problem with metals that are phyto-toxic or those metals that may enter the food chain. Some metals of concern translocate to the grain of the plant. Others are concentrated in the root structure, which may be the edible portion of the plant. Incineration temperature will volatilize some metals. Cadmium, mercury, selenium and zinc boil at temperatures below normal incineration temperature. Encapsulation is an expensive process due to the cost of the encapsulating material and the extra handling that is required for encapsulation. The encapsulated material must then be stored or buried. (Author's abstract)
W88-00636

LEACHING STUDY OF PNL 76-68 GLASS BEADS USING THE LLNL CONTINUOUS-FLOW METHOD AND THE PNL MODIFIED IAEA METHODS: A FINAL REPORT,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5B.
W88-00642

ENVIRONMENTAL REVIEW OF ONSHORE CANADIAN OIL AND GAS DRILLING AND PRODUCTION ACTIVITIES.
Zenon Environmental, Inc., Burlington (Ontario). Environment Canada, Environmental Protection Service, Ottawa, Economic and Technical Review Report No. EPS 3-EP-83-2, June 1983. 159 p, 50 fig, 36 tab, 91 ref.

Descriptors: *Waste disposal, *Drilling, *Environmental effects, *Oil wells, *Oil pollution, *Environmental impact statement, *Waste management, *Wastewater treatment, *Natural gas, *Well regulations, *Canada, Oil industry, Oil wastes, Reviews, Wastewater disposal, Southwestern Ontario, Oil, Regulations.

Current and proposed Canadian onshore oil and gas drilling and production activities are reviewed with respect to their potential for environmental effects. Canadian petroleum geology and related hydrogeology are described to provide a framework for discussion of the impact of soil and gas drilling and recovery operations, including tar sands development, and waste disposal practices. Environmental legislation applicable to oil and gas industry activities is also reviewed. Major environmental concerns identified include the potential for soil and groundwater contamination by drilling fluids, solid wastes, chemical additives, oils and brines, produced sands, and liquid wastes. The potential for contamination depends on handling and disposal practices and the geologic and hydrogeologic characteristics of the drilling and production site. Although fairly comprehensive legislation is in place, its effectiveness in the long-term has not been assessed, and no specific legislation exists for in situ tar sands development. Areas where knowledge is lacking and research is required have been identified. (Author's abstract)
W88-00662

HEALTH EFFECTS OF LAND APPLICATION OF MUNICIPAL SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W88-00679

LAND APPLICATION OF SEWAGE EFFLUENT FOR MISSOURI WATER RESOURCES CONSERVATION AND POLLUTION CONTROL,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-00732

INCINERATION OF WATER POLLUTANTS WITH ACTIVATED CHAR FROM COAL, WOOD, OR CROP RESIDUES IN A SYSTEM DESIGNED TO PRODUCE ENERGY AND PYROLYSIS BYPRODUCT CHEMICALS,
Missouri Univ.-Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W88-00733

LAND APPLICATION OF MUNICIPAL WASTEWATER: IMPACTS OF WATER RIGHTS AND LAND-USE CONTROLS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. E. Cox.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207023/AS. Price codes: A06 in paper copy, A01 in microfiche. Virginia Water Resources Institute, Blacksburg. Technical Completion Report, May 1983. 114 p, 144 ref. Project No. OWRT B-076-VA(1).

Descriptors: *Land disposal, *Wastewater disposal, *Water law, *Legal aspects, Riparian rights, Municipal wastewater, Land use, Zoning, Water rights.

Although land application in some cases offers an environmentally acceptable and cost-effective means of disposing of municipal wastewater, the feasibility of land disposal is affected by several institutional constraints. Two of the potentially most significant impediments include water rights and land use controls. Water right issues may arise when significant hydrologic modifications cause return flow patterns that affect the water supplies of other users. Both the appropriative and riparian doctrines of water law in the United States contain provisions to limit adverse effects of this type. In addition, land application projects may alter the flow of diffused surface water. Certain laws also impose constraints on such changes. Zoning ordinances are an important control over land application of wastewater when a locality wishes to establish such a project outside its own political boundaries. A second type of land use control consists of privately initiated tort actions that may be directed toward the operator of a land application project in response to such problems as odors, water contamination, or flooding. (Geiger-PTT)
W88-00744

COMBINATION GAS PRODUCING AND WASTE-WATER DISPOSAL WELL,
Department of Energy, Washington, DC.
R. M. Malinchak.
U.S. Patent No. 4,429,740; February 7, 1984. 6 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1039, No 1, p 117, February 7, 1984.

Descriptors: *Patents, *Wastewater disposal, *Disposal wells, *Underground waste disposal, Boreholes, Coal mines, Pumping, Conduits, Methane.

Wastewater from subterranean gas-bearing earth formations is disposed into a water-absorbent earth formation. A bore hole is extended from the surface through the gas-bearing earth formation into the water-absorbing earth formation. A casing is placed in the bore hole and perforations are provided through the casing at locations contiguous to two earth formations. A pump system is disposed in the casing and a conduit conveys water towards earth formations. A pump system is disposed in the casing and a conduit conveys water towards the water-absorbing earth formation. A barrier or water plug is disposed about the main conduit to prevent water flow through the casing, except through the main conduit. Bypass conduits above the barrier communicate with the main conduit to provide an unpumped flow of water to the water-absorbing earth formation. One-way valves in the main and bypass conduits provide flow of water only in the direction of the water-absorbing earth formation. (Cremmins-AEPCO)
W88-00749

PROCESS FOR STORING LIQUID WASTE IN SALT CAVITIES,
Wintershall A.G., Kassel (Germany, F.R.).
W. Lindorfer, W. Jahn-Held, L. J. Gerschler, B. Jandel, and F. Wartenpfuhl.
U.S. Patent No. 4,577,999; March 25. 1986. 5 p. Official Gazette of the United States Patent Office, Vol 1064, No 4, p 1710, March 25, 1986.

Descriptors: *Patents, *Liquid wastes, *Industrial wastes, *Water storage, *Underground storage, *Wastewater treatment, *Underground waste disposal, Salts, Chemical treatment, Caves.

Industrial liquid wastes that are pretreated to prevent the production of gases from reactions with salt are stored in cavities produced in natural salt deposits by solution mining. The liquid waste with a pH of 7 or more is blended with additional materials as required to produce a pumpable mixture which has a boiling point above 85 C, flash point above 65 C, vapor pressure at 60 C of up to 0.5 kp/sq cm, viscosity of less than 300 cP, and which forms no toxic or flammable gases. The mixture is then fed into a cavity, especially a cavern produced by solution mining and, after separation of the deposited mixture into heavier and lighted liquid phases, both phases are separately pumped out of the cavity or cavern. Additional pumpable mixtures are then fed into the area in the cavity or cavern, which has become empty. (Cremmins-AEPCO)
W88-00753

METHOD FOR DISPOSING OF WASTE MATERIALS,
Johnson (E.R.) Associates, Inc., Reston, VA.
W. L. Lennenmann.
U.S. Patent No. 4,428,700; January 31, 1984. 5 p, 2 fig, 2 ref. Official Gazette of the United States Patent Office, Vol 1038, No 5, p 1822, January 31, 1984.

Descriptors: *Patents, *Hazardous materials, *Radioactive waste disposal, *Underground waste disposal, *Excavation, *Land disposal, Waste disposal, Sulfur compounds, Concretes, Backfill, Barriers.

Waste materials, including radioactive waste, are emplaced in underground or surface excavations, in which modified sulfur cement or concrete is employed as a backfill or barrier material to encase the waste material. Modified sulfur cement is prepared by mixing molten sulfur at a temperature of about 120 - 180 C and 2 to 40 weight percent, preferably 2 to 10 percent, of a suitable organic modifier for about 4 hours. The resulting modified sulfur cement product can be used while still in the molten condition or be cooled to a solid that can be flaked, pelletized granulated, or otherwise reduced to a convenient size for subsequent remelt and use, especially with further additives such as aggregate and other inert materials. Suitable organic modifiers to improve the stability and other properties of the material include dicyclopentadiene, dipentene, vinylotuene, oligomers of cyclopentadiene, and mixture thereof. (Cremmins-AEPCO)
W88-00756

NUCLEAR DISPOSAL METHOD AND SYSTEM,
Nuclear Protection System, Inc., Norman, OK.
R. P. Hastings.
U.S. Patent No. 4,586,849; May 6, 1986. 4 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1066, No 1, p 246, May 6, 1986.

Descriptors: *Patents, *Radioactive waste disposal, *Waste storage, *Leaching, *Rock excavation, Waste disposal, Caves, Impervious boundaries, Surface runoff, Groundwater runoff, Radiolysis.

Radioactive waste is permanently disposed in a storage cavity in a bluff or other prominent rock formation above the ground surface water level and between two layers of rock which are substantially impervious to water. The layers of rock protect the disposal cavity from both groundwater seeping up from below and rain water from the surface. Radiolysis and the resulting corrosion is eliminated or at least deterred. Locating the cavity in the relatively soft more easily penetrated layer between the two impervious layers minimizes the cost of construction. Preferably, the cavity entrance is at the side of the bluff or mountain where the soft and possibly water permeable material is exposed, thereby further minimizing construction cost by eliminating the need for a vertical shaft through the upper layer of water impervious rock. The cavity may include a passage which is reinforced with a material such as concrete and is surrounded by boreholes to aid in dissipating the heat of the decay. (Cremmins-AEPCO)
W88-00757

METHOD OF SEALING OFF A MASS OF WASTE STOCK CONTAINING METAL CATIONS,
Soletanche, Nanterre (France).
D. Gouvenot.
U.S. Patent No. 4,615,643; October 7, 1986. 4 p, 3 tab. Official Gazette of the United States Patent Office, Vol 1071, No 1, p 218, October 7, 1986.

Descriptors: *Patents, *Industrial wastes, *Water storage, *Cations, *Heavy metals, *Grouting, *Soil disposal fields, *Waste disposal, Barriers, Silicates, Cements, Clays, Sodium carbonate, Alkali metals, Soil sealants.

Industrial waste masses stored in soil are sealed or insulated by a grouting barrier or curtain that retains heavy metallic cations. Hollows in the soil or fissured rock within the soil surrounding the masses are filled or injected with a grout containing 60 to 500 parts by weight of cement, 25 to 500 parts weight of clay, and 0 to 800 parts by weight of a natural or artificial siliceous product, per 1000 parts by weight of water. The grout also contains a mixture of 2 to 6 parts by weight of an alkali-metal pyrophosphate and/or alkali-metal tartrate to retain the heavy metallic cations. (Cremmins-AEPCO)
W88-00759

PROCESS FOR TERMINAL STORAGE OF PUMPABLE WASTES,
Wintershall A.G., Kassel (Germany, F.R.).
W. Lindorfer, and W. Jahn-Held.
U.S. Patent No. 4,576,513; March 18, 1986. 5 p. Official Gazette of the United States Patent Office, Vol 1064, No 3, p 1184-1185, March 18, 1986.

Descriptors: *Patents, *Waste storage, *Wastewater treatment, *Underground storage, *Specific gravity, *Salts, Underground waste disposal, Pumping, Liquid wastes, Industrial wastes, Crystallization, Solid wastes.

Water-containing pumpable waste containing a liquid phase is permanently stored by pumping it into a salt cavern and increasing the specific gravity of the liquid phase with soluble salts, which crystallize at cavern temperature with incorporation of water of crystallization from the liquid phase. The specific gravity of the liquid phase is increased to narrow the difference between the specific gravity of the salt mineral of the cavern wall and that of the liquid phase of the cavern contents. The caverns are then sealed. Aqueous, liquid, pumpable wastes, which can be stored in salt caverns and treated, include contaminated inorganic sludge, salt solutions, lime-and gypsum sludge, fly ash, flue dust, highly vicous slag and rubber sludge, sludge from cellulose manufacture, alkyl cellulose wastes, bitumen emulsions, acid resins and tars, sludge from petroleum refining, and residues from the production of organic compounds. (Cremmins-AEPCO)
W88-00761

PROCESS FOR THE BIOLOGICAL DEGRADATION OF HAZARDOUS WASTE BY-PRODUCTS,
For primary bibliographic entry see Field 5D.
W88-00762

METHOD OF DISPOSAL OR TEMPORARY STORAGE OF WASTE MATERIAL,
Preussag A.G. Metall, Goslar (Germany, F.R.).
K. Janssen, J. Meier, and S. Frank.
U.S. Patent No. 4,468,154; August 28, 1984. 10 p, 6 fig, 2 tab. Official Gazette of the United States Patent Office, Vol 1045, No 4, p 1638, August 28, 1984.

Descriptors: *Patents, *Solid waste disposal, *Water storage, *Liquid wastes, *Particulate matter, *Underground waste disposal, *Land disposal, *Entrainment, Waste diposal, Solid wastes, Pumping, Sludges, Hazardous materials.

Fine particulate solid waste material or a mixture of fine particulate and liquid waste material are disposed or temporarily stored by entrainment in a liquid and pumping through a pipeline into a natural or artificial, above-ground or underground dump or chamber in which the solid material is deposited. The small quantity of liquid, which is advantageously from 12% to 15% by weight of the mixture but can even be less than 10% by weight, results in high consistency material suitable for pumping and therefore leads to a kind of high-viscosity thrust-pumping in the form of a quasi-laminar flow with a uniform flow velocity over the pipe cross-section. (Cremmins-AEPCO)
W88-00763

STABILIZATION OF PARTICULATE MATERIAL,
For primary bibliographic entry see Field 8A.
W88-00765

METHOD AND APPARATUS FOR REMOVING CONTAMINANTS FROM SOIL,
Foster Wheeler Energy Corp., Livingston, NJ.
R. J. Russomano.
U.S. Patent No. 4,611,950; September 16, 1986. 7 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1070, No 3, p 1166, September 16, 1986.

Descriptors: *Patents, *Wastewater treatment, *Soil contamination, *Soil water, *Soil treatment, *Water pollution prevention, Water pollution control, Groundwater pollution, Pumping, Spraying, Conduits, Industrial wastes.

Contaminants are removed from the soil in situ or at a remote site to prevent groundwater contamination. For remote decontamination, a volume of earth is evacuated and a pit is formed and lined with clay, concrete, or the like. The soil to be contaminated is placed in the pit for treatment. The decontaminated material could then be removed to another location after the decontamination operation has been completed and additional contaminated material could be placed in the pit. Spray nozzles are used to flood the surface of the contaminated soil with water, which soaks into soil and mixes with the contaminants. The mixed water and contaminants travel through the soil to a set of vertical inlet risers positioned in the soil and located at a distance from the spray nozzles. The water-contaminant mixture is drawn through the inlet

risers via a collection conduit system to a holding tank. The water is drawn through the inlet risers by producing a high velocity stream of water using venturi device and passing the stream over the upper end of the removal conduit. The vacuum created by the high velocity stream causes the water in the inlet riser to flow into the removal conduit system. (Cremmins-AEPCO)
W88-00766

TOXICS MANAGEMENT IN CALIFORNIA.
California Hazardous Substance Task Force, Sacramento, CA.
For primary bibliographic entry see Field 6E.
W88-00919

PHASE II: FLOW THROUGH CLAY LINERS,
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
C. J. Miller, and M. Mishra.
Available from the National Technical Information Service Springfield, VA 22161, as PB87-217220/AS. Price codes: A05 in paper copy, A01 in microfiche. Michigan Institute of Water Research, E. Lansing, Technical Report No. G1232-02, March 1987, 91 p, 4 fig, 4 photos, 1 tab, 53 ref, 2 append. Contract No. 14-08-0001-G1232. Project No. USGS G1232-02.

Descriptors: *Landfills, *Liners, *Clay liners, *Michigan, Groundwater, Seepage, Hazardous wastes, Data collections, Leakage, Landfill leaks.

The problem of moisture movement through cover clay liners of landfills is important because that movement ultimately controls the volume of leachate that may impact local groundwater sources. In this project, the moisture movement through cover liners is considered using data collected at a field site in southeastern Michigan. The importance of crack development to moisture transport is investigated and a review of current research in this area is presented. Possible extensions to the clay liner problem are discussed. (Mich. St. Univ., IWR)
W88-00961

5F. Water Treatment and Quality Alteration

FINANCIAL BURDENS AND ECONOMIC COSTS IN EXPANDING URBAN WATER SYSTEMS,
North Carolina Univ., Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6C.
W88-00025

THEORY AND PRACTICE FOR THE TESTING AND OPERATION OF ULTRAVIOLET SYSTEMS FOR WATER TREATMENT,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
K. Mechsner.
Aqua AQUAAA, No. 2, p 73-79, 1987. 9 fig, 5 tab, 19 ref.

Descriptors: *Ultraviolet radiation, *Disinfection, *Drinking water, *Water treatment, Bacteria, Infection, Diseases.

UV radiation is an important ecological factor. Among other effects it exhibits bactericidal activity with a maximum at a wavelength of 260 nm. UV interferes directly with the DNA structure in living cells. In response to increasing requirements for treated drinking water, UV-disinfection methods have become increasingly important due to the non-toxic nature of the disinfection products and due to the efficient operation of low pressure Hg lamps. When compared with other important disinfectants, UV methods are found to be more likely to meet the demands of modern drinking water disinfection. UV methods offer distinct advantages with respect to the kinetics of disinfection and to the fact that no adverse effects of the radiation are seen in the treated water. Experiments carried out under operating conditions demonstrated how UV-systems can be assessed and their limitations under variable conditions encountered in technical-scale operation. (Author's abstract)
W88-00061

PARTICLE REMOVAL BY HORIZONTAL-FLOW ROUGHING FILTRATION,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
M. Wegelin, M. Boller, and R. Schertenleib.
Aqua AQUAAA, No. 2, p 80-90, 1987. 24 fig, 1 tab, 7 ref.

Descriptors: *Water treatment, *Filtration, *Pretreatment of water, *Suspended solids, *Developing countries, Particulate matter, Wastewater treatment, Drinking water, Turbidity, Economic aspects, Sand filters, Filter media.

Horizontal-flow Roughing Filtration (HRF) is presented as an alternative pretreatment method prior to Slow Sand Filtration (SSF). The prefilters efficiently remove solid matter from turbid water without the use of chemicals or mechanical equipment. Developing countries are therefore most interested in this process which recently has been introduced successfully. The HRF consists of a box filled with different sized gravel through which the water flows horizontally. Sedimentations is the main process in HRF responsible for separating the solid matter from the water. Laboratory tests were conducted in Switzerland and field tests in Thailand and Tanzania. These tests confirmed that HRF, as a pretreatment, can be combined with SSF to prolong the running lifetime of SSF to the several months necessary for reasonable filter operation. The investigations also show that occasional filter drainage will prolong operational time of HRF installations considerably, reducing the frequency of manual cleaning. (Airone-PTT)
W88-00062

THEORETICAL ANALYSIS AND PRACTICAL APPLICATION OF THE KINETIC MODEL OF FLOCCULATION IN THE INTERPRETATION OF JAR TESTS,
Antwerpse Waterwerken (Belgium).
For primary bibliographic entry see Field 5D.
W88-00063

SAMPLING FOR WATER QUALITY CONTROL,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
A. D. Hulsmann.
Aqua AQUAAA, No. 2, p 98-101, 1987. 4 fig, 2 ref.

Descriptors: *Water treatment, *Water distribution, *Statistical methods, *Sampling, *Water quality standards, Statistical analysis, Data interpretation, Water quality, Drinking water, Heavy metals, Water storage, Stagnant water, Plumbing, Netherlands.

The number of samples necessary to measure changes in water quality in the distribution system and in the drinking water installation depends on the scatter in results. In the case where parameters change according to hydraulic circumstances special attention has to be paid to 'high risk' areas. To determine changes in water quality during transportation, analysis should be carried out on running water obtained from a tap that is used regularly. The capacity of the water to dissolve heavy metals should be determined at the pumping station under standardized conditions. There is a need for additional guidelines for water quality at the tap since such guidelines do not exist in the Netherlands. The period between production and consumption of drinking water cannot be extended indefinitely. Consumers should be advised in some cases (premises with irregular water demand, lead pipes, first water drawn after a holiday) to flush the installation (in premises with lead pipes, flushing may not always suffice to reduce the lead content to under 50 micrograms/l). In premises with copper pipes the EC guideline for lead is sometimes exceeded as a result of corrosion of the soldered fittings. (Airone-PTT)
W88-00064

THM FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5A.
W88-00065

EVOLUTION OF ORGANICS IN A POTABLE WATER TREATMENT SYSTEM,
Compagnie Generale des Eaux, Paris (France). Groupe Traitement de l'Eau.
G. Bablon, C. Ventresque, and F. Roy.
Aqua AQUAAA, No. 2, p 110-113, 1987. 7 fig, 12 ref.

Descriptors: *Taste, *Pretreatment of water, *Carbon filters, *Chlorination, *Drinking water, *Water treatment, *Activated carbon, Biomass, Biological treatment, Filtration, Ozonation, Testing, Chlorinated hydrocarbons, Organoleptic properties.

The commissioning at the Choisy-le-Roi plant (capacity 800,000 cu m/day) of an activated carbon filtration unit behind the ozonators and the discontinuation of prechlorination have considerably improved the taste of the water supplied. An in-depth study of the origin of taste in the water was undertaken on this occasion to provide accurate information as to the sources of taste. At Choisy-le-Roi, the action of chlorine on organic matter is the main cause of the generation of tastes in the water. Certain molecules constituting the organic matter dissolved in the raw Seine water would appear to form sapid compounds with the chlorine, and these are detectable at very low concentrations. The evolution of these molecules in the treatment system was monitored, and a better understanding developed of the possibilities of their removal, oxidation and bioconversion, with the aim of controlling the taste of the water produced. Original methods were used for estimating the bacterial biomass activity in the activated carbon filters and for determining the biodegradable fraction of dissolved organic carbon. The association of ozonation and activated carbon filtration stages in a biological treatment system results in an increase in the organic matter fraction removed by bioconversion. (Author's abstract)
W88-00066

ASSESSMENT OF CHLORINE DIOXIDE AS A MEANS OF LIMITING THE FORMATION OF ORGANOHALOGENATED COMPOUNDS (EVALUATION DU BIOXYDE DE CHLORE COMME MOYEN LIMITANT LA FORMATION DE DERIVES ORGANO-HALOGENES),
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
R. Savoir, L. Romnee, and W. J. Masschelein.
Aqua AQUAAA, No. 2, p 114-117, 1987. 4 fig, 2 tab, 15 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Chemical treatment, *Wastewater treatment, Disinfection, Chemical potential, Chemical reactions, Oxides, Chloroform, Drinking water.

It has been established that the use of pure chlorine dioxide in water treatment practice does not result in the significant formation of trihalomethanes (THM). On the other hand, the question of the formation of non-volatile organohalogenated compounds (NPOX) remained open. The potential formation of these compounds by exhaustive reaction, i. e. at least 20 mg/l of pure chlorine dioxide, was examined on raw unfiltered Meuse water. Based on the average data for 1985, the data for this excess treatment indicate an insignificant formation of THM (< 1 microg/l) and formation of 34 microg/l of NPOX. In similar conditions, exhaustive chlorination gave 195 microg/l THM and 1087 microg/l NPOX. The organochlorinated compounds produced by chlorine dioxide therefore amount to only 3% of the concentrations obtained with free chlorine. Their formation is negligeable when

chlorine dioxide is used in water treatment at a concentration of 1 mg/l. (Author's abstract)
W88-00067

MEASUREMENT AND CONTROL OF FEED WATER AND PRODUCT WATER COMPOSITION,
Dow Chemical Co., Freeport, TX. Electrochemicals Lab.
For primary bibliographic entry see Field 3A.
W88-00091

INDICES OF DRINKING WATER CONCERNED WITH TASTE AND HEALTH,
Osaka Univ. (Japan). Dept. of Environmental Engineering.
S. Hashimoto, M. Fujita, K. Furukawa, and J.-I. Minami.
Journal of Fermentation Technology JFTED8, Vol. 65, No. 2, p 185-192, April 1987. 3 fig, 7 tab, 15 ref.

Descriptors: *Drinking water, *Water quality standards, *Taste, *Human diseases, *Water treatment, Calcium, Potassium, Silica, Sulfates, Magnesium, Japan, Mortality, Lethal limit, Evaluation, Classification.

Using the results of a sensory test of drinking water and some findings from the literature, the requisites for tasty and healthy water were examined. Calcium, potassium and silica were correlated with the good taste of water and sulfates and magnesium were factors making water unsavory. The concentration difference between calcium and sodium was closely correlated with the death rate due to apoplexy and, consequently, the span of life in Japan. From these findings, two equations were derived as indicators of tasty water and healthy water. They were named the O index and K index, respectively, and were expressed as follows; O index = (Ca+K+SiSO2)/(Mg+SO4) milligrams/L and K index = Ca-0.87 Na milligrams/L. Tasty water had an O index of > 2.0 and healthy water had a K index of > 5.2. O and K indices were estimated for Japanese waters, including representative drinking water, 218 rivers, and famous river waters selected by the Environmental Agency. These waters were classified as tasty and/or healthy according to the results. This classification seems to be rational because the findings are consistent with everyday experience. (Author's abstract)
W88-00149

NITRATE REMOVAL: A COMPROMISE SOLUTION,
Cranfield Inst. of Tech. (England). School of Water Sciences.
G. Solt.
Water Quality International, No. 1, p 29-30, 1987.

Descriptors: *Water treatment, *Potable water, *Water treatment, *Nitrate removal, *Ion exchange, *Biological, Methanol, Ethanol, Acetic acid, Nitrates, Nitrites, Costs.

Of the many available options for nitrate ion removal from potable waters only ion-exchange and anoxic microbiological processes have shown promise. But, these are expensive and complicated. For example, the ion exchange process requires regeneration which is often incomplete and produces another pollutant stream. The microbiological process requires the addition of a carbon source, methanol, for example, may affect palatability. Incomplete conversion of nitrate ion may produce the nitrite ion which is more objectionable than nitrate ion. (Ray-PTT)
W88-00156

DISINFECTION FOR REUSE,
Utah State Univ., Logan. Coll. of Engineering.
For primary bibliographic entry see Field 5D.
W88-00178

WATER SUPPLY,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
IN: Environmental Pollution and Control, 2nd edition. Butterworth, Boston, MA. 1983. p 57-66, 3 fig.

Descriptors: *Water supply, *Hydrologic cycle, *Water distribution, Groundwater, Surface water, Conduits, Reservoirs.

Water supply is discussed in terms of the hydrologic cycle and water availability, groundwater supplies, surface water supplies, and water transmission. The hydrological cycle consists of precipitation, infiltration into the ground or runoff into surface watercourses, followed by evaporation and transpiration into the atmosphere. Groundwater may be a direct water supply source or an indirect one via streams receiving groundwater. Surface water supplies fluctuate more than groundwater supplies. Reservoirs are constructed to improve the dependability of the supply. Water transmission systems include pressure conduits and gravity flow conduits as well as service reservoirs, which help meet peak demands. (See also W88-00314) (Cassar-PTT)
W88-00333

CHEMISTRY IN WATER REUSE: VOLUME 2.
For primary bibliographic entry see Field 5D.
W88-00434

SELECTIVE ADSORPTION OF ORGANIC HOMOLOGS ONTO ACTIVATED CARBON FROM DILUTE AQUEOUS SOLUTIONS-SOLVOPHOBIC INTERACTION APPROACH: DEVELOPMENT AND TEST THEORY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
G. Belfort.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 207-241, 11 fig, 7 tab, 50 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Activated carbon, *Adsorption, *Organic compounds, Solvophobic theory, Kinetics, Model studies, Solubility, Aliphatic compounds, Aromatic compounds.

A comprehensive theory, based on the solvophobic interaction theory of Sinanoglu is given for the equilibrium adsorption of an organic solute from a dilute aqueous solution onto an adsorbent such as activated carbon. This approach may be useful in design of large-scale water or wastewater treatment plants. An expression is derived for the extent of adsorption with essentially no adjustable constants. Branching, cyclization, position isomerism and competitive adsorption are automatically accounted for without introducing additional terms or adjustable constants. Model testing produces linear correlations of the extent of adsorption of a series of normal aliphatic organic homologs. The theory incorporates a wide span of experimental conditions, including a comparison of the adsorption of similar organic compounds on different adsorbents and a comparison of the adsorption of different organic solutes on the same adsorbent. Simplified analytical expressions result under special conditions and assumptions, allowing the extent of adsorption to be predicted as a function of the simple geometric characteristics of the solute or its nonpolar moieties. The simplified model is tested for the aqueous adsorption of aliphatic homologous series (alcohols, ketones, aldehydes, acids, and acetates) and aromatic homologous series (alkyl benzenes and alkyl phenols). In most cases the model successfully correlates the adsorption data within homologous groups. As a comparison, similar correlations with molecular weight or solubility are poorer for 13 out of 16 cases tested. (See also W88-00434) (Cassar-PTT)
W88-00445

EXPERIMENTALLY OBSERVED ANOMALIES IN COMPETITIVE ADSORPTION AND REEXAMINATION OF SOME AVAILABLE MODELS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
W. H. Frye, and F. A. DiGiano.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 243-267, 16 fig, 2 tab, 13 ref. Project No. WR-A091.

Descriptors: *Water treatment, *Activated carbon, *Adsorption, *Organic compounds, Kinetics, Cresol, Acetophenone, Veratrole, Equilibrium.

A study of the competitive equilibrium and dynamic sorptive behavior of three model compounds (o-cresol, acetophenone, and veratrole) showed that single solute equilibrium data is not always reliable for predicting multicomponent adsorption. o-Cresol, which appeared to be well adsorbed according to its single-solute equilibrium data, was actually displaced from the granular activated carbon surface to an unexpected extent by the other two compounds. The differences in adsorption kinetics could not have been predicted based in the size and structure of the molecules. A possible explanation for this phenomenon is that acetophenone and veratrole were above their melting points at the temperature of the experiment; o-cresol was a solid. (See also W88-00434) (Cassar-PTT)
W88-00446

APPLICATION OF THERMAL DESORPTION-GAS CHROMATOGRAPHY/MASS SPECTROMETRY TO MONITOR DYNAMIC ADSORPTION IN ACTIVATED CARBON,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5A.
W88-00447

ADSORPTION OF BENZENE FROM WATER BY ACTIVATED CARBON,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
M. Pirbazari, and W. J. Weber.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 285-307, 22 fig, 3 tab, 12 ref. Contract No. R-804369.

Descriptors: *Water treatment, *Fate of pollutants, *Activated carbon, *Adsorption, *Benzene, Organic compounds, Equilibrium, Kinetics, MADAM model, Model studies.

The results of adsorption-desorption equilibrium studies indicate that adsorption of benzene is readily reversible. It was further demonstrated that substantial amounts of benzene were released from adsorber columns in the course of dynamic desorption studies. These results suggest that the adsorption of benzene on carbon occurs predominantly as a result of van der Waals attraction forces (physical adsorption), which are generally characterized by low energies of adsorption and ready reversibility. The effectiveness of activated carbon for removal of benzene from water is adversely affected by competition for adsorption with background organic substances such as humic acids. The MADAM adsorption model was generally able to simulate and predict the performance of fixed-bed adsorbers for removal of benzene. Prediction accuracy was adversely affected by severe fluctuations in influent concentration, most likely due to reequilibrium phenomena operative in adsorbers under such conditions. Observations of apparently different rate controlling processes in mini-columns and pilot columns suggest a rather fine balance between external film diffusion and internal surface diffusion with respect to which is the mass transport-limiting mechanism for benzene adsorption in a given water treatment application. Even within the relatively narrow range of variables of interest for such applications, the rate-limiting process appears to depend in significant measure on the physical characteristics of a particular system including column type, hydraulic regime and carbon particle size. (See also W88-00434) (Author's abstract)
W88-00448

ADSORPTION OF POLYCHLORINATED BIPHENYLS FROM WATER BY ACTIVATED CARBON,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W88-00449

INFLUENCE OF CONTACT TIME AND TURBULENCE ON THE ADSORPTION OF ORGANICS ON POWDERED ACTIVATED CARBON,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
A. P. Meijers, and R. C. Van der Leer.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 341-353, 9 fig, 8 tab.

Descriptors: *Water treatment, *Activated carbon, *Adsorption, *Taste, Mixing, para-Nitrophenol, Rhine River, Organic compounds, Chlorine compounds.

Jar tests and pilot experiments were performed on several powdered activated carbons used in water treatment to improve taste and odor. Waters used included a model water containing para-nitrophenol in tap water (characteristic of micropollutants in the Rhine River) and water from the River Rhine. In the jar tests a G value of at least 65/sec was necessary for good adsorption (70-80%). At low G values the carbon settled to the bottom of the jar, contributing little to further adsorption. Jar tests of river water showed good removal of extractable organic chlorine (EOCl) compounds and taste at contact times of 40 min and 24 hours with a dosage of at least 20 mg/L carbon; ultraviolet extinction decreased moderately. Considerable EOCl was adsorbed after a 20-min contact time. This was confirmed at the Dunewaterworks of the Hague, the Netherlands. After a carbon dosage of about 10 g/cu m of activated carbon, the influent water flowed through a labyrinth with a contact time of 23 min. No carbon settling occurred. The calculated G value was 77/sec. However, taste improvement was insufficient. Part of the carbon settled in a basin after the labyrinth. Rapid sand filtration removed the remaining carbon and further improved the taste. (See also W88-00434) (Cassar-PTT)
W88-00450

REACTION OF OZONE WITH POLYAROMATICS IN WATER,
Technische Hogeschool Delft (Netherlands).
For primary bibliographic entry see Field 5B.
W88-00453

EFFECTIVENESS OF A EUROPEAN SURFACE WATER TREATMENT SYSTEM, ESPECIALLY IN REMOVAL OF ORGANICS,
M. Schalekamp.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 465-495, 47 fig, 2 tab, 13 ref.

Descriptors: *Water treatment, *Water pollution sources, *Organic compounds, Rivers, Rhine River, Lakes, Switzerland, Germany, The Netherlands, Surface water, Filtration, Disinfection, Chlorination, Ozonation, Activated carbon, Adsorption, Coagulation, Chlorine dioxide, Flocculation, Neutralization, Taste.

A review of water treatment in European countries indicates that water supply plants have reached the current limits of technology. However, more can be done in treating wastewater. The Rhine River is severely to excessively contaminated from Karlsruhe onward. To accomodate to increasingly poor raw water quality, the water treatment plants have developed multistage processes such as the one used at Weesperkarspel, The Netherlands. It uses dilution with polder water, rapid filtration, ozonation, activated carbon, coagulation, rapid filtration, slow sand filtration, deacidification, and chlorination. At Weisbaden, Germany, river bank filtration had to be replaced with a 10-stage process. An 8-stage treatment process planned for Swiss lake water includes prechlorination, flocculation, double-layer rapid filtration with sand and pumice, neutralization, ozonation, activated carbon filtration, and chlorine dioxide treatment. This sophisticated process is necessary because of the following problems experienced in treating lake water since 1960: phenol inflow, rapid increase in microorganisms, recontamination, increase in nanoplankton, rapid clogging of filters, increase in phosphates, oxygen depletion, carbonic acid, mussels, fauna in filters, flavor problems trace elements, and water pollution. (See also W88-00434) (Cassar-PTT)
W88-00455

INTERPRETATION OF THE ADSORPTION OF VIRUSES BY CLAYS FROM THEIR ELECTROKINETIC PROPERTIES,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
D. H. Taylor.
IN: Chemistry in Water Reuse: Volume 2. Ann Arbor Science, Ann Arbor, MI. 1981. p 595-612, 7 fig, 34 ref. Contract No. R804743.

Descriptors: *Water treatment, *Wastewater treatment, *Viruses, *Adsorption, *Clays, Kinetics, Electrochemistry, Colloids.

Combining electrokinetic studies of viruses and clay minerals has allowed qualitative description of their mutual interactions in dilute electrolytes by the accepted theories of colloid adsorption: namely, that the overall interaction is a combination of attractive and repulsive forces. Inherent attractive forces are probably mainly London-van der Waals forces, although solvation and specific interactions may also contribute. Repulsive forces with sufficient strength to prevent adsorption develop when particles of strong, similar electrostatic charge approach. Use of viruses and surfaces suitable for electrokinetic and adsorption studies may allow the nature of the inherent attractive forces to be determined, the role of the nature of of the surface in the interaction to be further elucidated and the condition under which viruses will adhere firmly to different surfaces to be predicted more reliably. (See also W88-00434) (Author's abstract)
W88-00461

ADEQUACY OF DISINFECTION FOR CONTROL OF NEWLY RECOGNIZED WATERBORNE PATHOGENS,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5D.
W88-00475

WATER STILL WITH A CYCLONE LIQUID-VAPOR SEPARATOR,
Fisons PLC, Ipswich (England).
For primary bibliographic entry see Field 3A.
W88-00494

METHOD AND APPARATUS FOR PRODUCING ULTRAPURE WATER,
Millipore Corp., Bedford, MA.
R. S. Hegde, and G. C. Ganzi.
U.S. Patent No. 4,430,226; February 7, 1984. 6 p, 2 ref. Official Gazette of the United States Patent Office, Vol. 1039, No 1, p 276, February 7, 1984.

Descriptors: *Patents, *Water treatment, *Activated carbon, *Resins, *Ion exchange, Organic compounds, Pretreatment of water, Resistivity, Feedwater treatment, Filtration.

Water is deionized and organic contamination is reduced by passing the water through a cartridge containing a particulate admixture of activated carbon and mixed ion exchange resins. Pretreatment water is fed to one or more ion-exchange cartridges, and then to one or more admixture cartridges. The admixture cartridges may include a final microporous filter. A conduit discharging water from the final cartridge is fitted with a resistivity or other meter to monitor the quality of the effluent water. A conduit downstream of the mixture is provided with a valve or other system for recycling the water through the ion-exchange and admixture cartridges until the desired quality is obtained. Admixtures require an initial rinse cycle in relatively pure water to produce 16-18 megohm/cm effluent. This may be accomplished by recycling as described, but requires an extended period of time. This time can be substantially reduced by soaking the admixture in deionized water for one hour. Preferably the admixtures are first rinsed for 5-10 minutes in flowing deionized water, then left in non-flowing deionized water to soak for one or more hours. The flow is resumed until the desired quality is attained. The admixtures may also be pre-soaked prior to the installation in the flowing system. (Cremmins-AEPCO)
W88-00495

PERVIOUS SURROUND METHOD OF WASTE DISPOSAL,
For primary bibliographic entry see Field 5E.
W88-00497

POND WITH FILTERED WATER,
Komarom Megyai Tanacsi Tervezo Iroda, Esztergom (Hungary).
A. Balough, and L. Szeher.
U.S. Patent No. 4,452,548; June 5, 1984. 6 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1043, No 1, p 231, June 5, 1984.

Descriptors: *Patents, *Ponds, *Water pollution control, *Water treatment, *Filtration, *Dams, Recreation, Irrigation, Intakes, Water storage, Industrial water, Well filters.

A filter dam is built between polluted water and a pond used for water production and storage and for recreation, irrigation and industrial use. The pond is provided with water intakes. Shore filter wells are arranged in rows on the banks of the pond. A board well is sunk in the pond. Twice-filtered water can be drawn off the shore filter and board wells, because the water is filtered for the second time through the bottom of the bank or the bed of the pond. A water catchment on the surface of the pond, a drain weir, and a booster pump serve as water intakes for the stock of water above the ground. The drain weir can also function as a high-tide conduit. The booster pump can be provided with a fairly long suction pipe to lift the more heavily polluted water in the vicinity of the bottom of the pond to the surface. (Cremmins-AEPCO)
W88-00501

METHOD FOR MINING AND RECLAIMING LAND,
For primary bibliographic entry see Field 4A.
W88-00504

IODINE DISINFECTION DISPENSER,
D. H. O'Dowd, and G. W. J. Barry.
U.S. Patent No. 4,555,347; November 26, 1985. 11 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1060, No 4, p 1712, November 26, 1985.

Descriptors: *Patents, *Iodine, *Disinfection, *Water treatment, *Water supply, *Filtered water reservoirs, *Water conveyance, Conduits, Dispensers.

A method and a device are described for dispensing a disinfectant level of iodine using a water supply that flows through a conduit. A predetermined portion of the water is introduced into a sealed container having a reservoir and an intercommunication chamber below the reservoir. The reservoir contains iodine crystals, and is large enough to hold a quantity of water proportional to the maximum flow rate attainable through the conduit and such that a minimum concentration of 120 parts/million (milligrams/L) is obtainable as an outflow from the container when the supply of water is at least above freezing. The predetermined portion of the water introduced into the chamber and outflowing from the reservoir above the iodine crystals passes through the filter material and be-

tween the iodine crystals. The water is carried by an inlet opening into the chamber and an outlet opening from the reservoir above the iodine crystals. (Cremmins-AEPCO)
W88-00515

METHOD FOR DEWATERING NON-AQUEOUS LIQUIDS,
Texaco, Inc., White Plains, NY.
W. M. Sweeney.
U.S. Patent No. 4,390,417; June 28, 1983. 8 p, 4 fig, 3 tab. Official Gazette of the United States Patent Office, Vol 1031, No 4, p 1373, June 28, 1983.

Descriptors: *Patents, *Hydrocarbons, *Dewatering, *Sensors, *Fuel, *Streamflow, Streams, Catalysts, Chemical reactions, Conduits, Sumps.

A flowing stream of non-aqueous liquid containing water is passed through a conduit which contains an acid resin catalyst. An inlet passage is used to inject a dewatering chemical into the stream prior to its contact with the acid resin catalyst. The system also contains a watersensing probe in the stream prior to the point at which the inlet passage is positioned, and a sensor associated with the probe for detecting water in the flowing stream. A signal is generated by the sensor in accordance with the water content detected by the watersensing probe to control the passage of the dewatering chemical to the inlet passage. The most common liquids with which this apparatus is intended to be used are hydrocarbon fuels. Typical of the heavy (heavier than gasoline) fuels may be fuel oil or more preferably diesel fuel. Apparatus for dewatering flowing diesel fuel includes an agglomerator in a conduit, a sump containing an acid resin catalyst, a sensor in the sump for detecting water, and a conduit for injecting dimethoxyketal into the sump, in accordance with a signal generated by the sensor. The dimethoxyketal reacts with the water in the diesel fuel in the presence of the catalyst whereby the flowing diesel fuel is dewatered. (Cremmins-AEPCO)
W88-00530

PURIFICATION OF HYDROCARBON STREAMS,
Phillips Petroleum Co., Bartlesville, OK.
For primary bibliographic entry see Field 3C.
W88-00531

SULFITE DESTRUCTION OF DIRECT ACTING MUTAGENS IN DRINKING WATER,
Minnesota Univ., Minneapolis. Regents.
A. M. Cheh.
U.S. Patent No. 4,364,835; December 21, 1982. 5 p, 5 tab, 4 ref. Official Gazette of the United States Patent Office, Vol 1025, No 3, p 1008, December 21, 1982.

Descriptors: *Patents, *Water treatment, *Chlorination, *Chemical treatment, *Wastewater treatment, *Drinking water, *Mutagens, *Sulfites, Industrial water, Municipal water, Sulfur compounds, Industrial wastewater, Municipal wastewater, Potable water.

The reduction of non-volatile mutagens is attained by introducing sulfite into drinking water produced by municipal and private water treatment plants and into chlorinated municipal and industrial wastewaters. After determining the residual chlorine content of the water, sulfite is introduced in an amount in excess of that which is necessary to eliminate the residual chlorine. The sulfite may be introduced in the form of a soluble metallic sulfite or bisulfite salt, such as an alkaline metal sulfite or bisulfite, preferably sodium or potassium. However, sulfite is preferably introduced into the water as gaseous sulfur dioxide since partial dechlorination of drinking water with SO2 is an established treatment procedure. The extent to which sulfite destroys direct acting mutagens will depend on the chemical rates of reaction. Thus higher concentrations of sulfite would destroy mutagens more rapidly. The upper limit of the sulfite concentration would depend on balancing the increased cost of adding greater amounts of sulfite against the diminishing returns of mutagen destruction. The lower limit of the sulfite concentration is determined by the requirement that there be enough sulfite to first destroy the residual chlorine and then destroy the mutagens. Thus, sulfite is usually introduced into the water in amounts at least 1.2 to 10 times the stoichiometric ratio of sulfite to chlorine, usually not exceeding about 0.0002 moles of sulfite/L. (Cremmins-AEPCO)
W88-00533

GROUND MOISTURE TRANSFER SYSTEM,
For primary bibliographic entry see Field 3A.
W88-00562

DISTILLATION APPARATUS WITH A LIQUID-VAPOR SEPARATING DEVICE HAVING THREE CHAMBERS,
For primary bibliographic entry see Field 3A.
W88-00563

METHOD AND APPARATUS FOR DISTILLATION,
International Microporous Technology, Inc., Menlo Park, CA.
For primary bibliographic entry see Field 3A.
W88-00564

WOBBLE TUBE EVAPORATOR WITH WHIP ROD FLUID DISTRIBUTOR,
For primary bibliographic entry see Field 3A.
W88-00565

AUTOMATED SOLAR STILL,
For primary bibliographic entry see Field 3A.
W88-00567

DISTILLED WATER PRODUCTION DEVICE,
Yamamoto Scientific Co. Ltd., Tokyo (Japan).
M. Wakasugi.
U.S. Patent No. 4,540,470; September 10, 1985. 4 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1058, No 2, p 767, September 10, 1985.

Descriptors: *Patents, *Distilled water, *Distillation, *Control systems, *Flow control, *Cooling water, Flow rate, Boiler water, Condensers, Water cooling, Evaporation.

Distilled water production is controlled by feeding cooling water to a boiler after it has passed through a condenser. The control system consists of a strainer along the water supply flow path; a flow rate control valve, containing a pressure compensator and maintaining a constant flow rate regardless of fluctuations in the pressure of the primary water supply; and a solenoid valve which opens and closes. The rate of flow of cooling water supplied from the condenser to the boiler is adjustable and is independent of the flow of cooling water through the condenser. (Hancuff-AEPCO)
W88-00572

WATER PURIFICATION APPARATUS,
J. G. Bjorklund.
U.S. Patent No. 4,601,789; July 22, 1986. 9 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1067, No 3, p 1194, June 17, 1986.

Descriptors: *Patents, *Heated water, *Water treatment, *Distilled water, *Distillation, Boiled water, Heating, Domestic water, Condensors, Water supply, Water tanks, Feedwater treatment, Vaporization.

A water treatment system provides water distillation on a small quantity basis through the use of a device adaptable to a common household hot water heater. A water distilling and hot water heating container is enclosed and essentially vapor-tight. The container holds a quantity of water while leaving a vapor space above a certain level. A feedwater intake connected to the container provides a water rate of flow in excess of that intended to be taken off as distilled water. A heating device connected to the container heats the water to boil. This device is controlled to vary the quantity of water boiled into the vapor space and removed as product water. A wastewater exit port device is connected through the container wall to remove any accumulated liquid above a certain level in the container. A distilled water exit port device positioned above the water level in the vapor tank is equipped with a cold water feed and a hot water draw. A condensing device is connected to the distilled water exit port to carry the water vapor and transfer the heat of condensation to the water in the hot water tank. Additionally, a wastewater heat exchanger is connected to the wastewater exit port to transfer the heat from the wastewater to the water in the hot water tank. (Hancuff-AEPCO)
W88-00575

DESALINIZATION APPARATUS,
Mitsubishi Electric Corp., Tokyo (Japan).
For primary bibliographic entry see Field 3A.
W88-00576

METHOD AND AN INSTALLATION FOR PURIFYING INDUSTRIAL WASTE WATER, PARTICULARLY PROCESS WATER FROM DYEING WORKS,
For primary bibliographic entry see Field 5D.
W88-00577

SOLAR DISTILLATION METHODS AND APPARATUS,
For primary bibliographic entry see Field 3A.
W88-00578

WATER DEGASIFICATION AND DISTILLATION APPARATUS,
J. C. Ellis.
U.S. Patent No. 4,420,374; December 13, 1983. 9 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1037, No 2, p 679-680, December 13, 1983.

Descriptors: *Patents, *Distilled water, *Water treatment, *Degasification, *Distillation, Boilers, Condensers, Heated water, Evaporation, Taste, Odor control, Vaporization.

Water degasification and distillation are combined in a single apparatus consisting of two separate but connecting chambers. One chamber is for degasifying the water; the second one is for evaporating it. The advantage of this system over a single boiler-type is associated with the taste and odor of the product waters. The two-chamber system has the advantage of being able to degasify the water before it enters the boiler section where it is vaporized. The boiler and fresh water tanks are separate but adjoined to each other. The water level in both tanks is maintained the same through a below the water surface connecting tube. The tube connects from the mid-depth of the boiler and extends to the bottom of the fresh water in the distillation chamber. Above the water surface in the boiler chamber is a steam collection tube which passes through the walls of the boiler and the degasifying chamber. It then coils through the distillation tank. The steam produced in the boiler condenses by passing through the coils in the distillation chamber. The condensing of steam heats the water in the distillation chamber, thereby driving off the volatile gases. As the water volatilizes in the boiler chamber and is removed as steam, makeup water is supplied through the tubing from the bottom of the distillation chamber. Fresh water is supplied as makeup to the distillation chamber. Because the water being supplied to the boiling chamber has had the volatile chemicals removed, the product water is odor and tastefree. (Hancuff-AEPCO)
W88-00581

HIGH RATE SOLAR STILL AND PROCESS,
For primary bibliographic entry see Field 3A.
W88-00592

PROCESS FOR DISTILLING WATER,
Oriental Metal Mfg. Co., Amagasaki (Japan).

For primary bibliographic entry see Field 3A.
W88-00593

AUTOMATICALLY OPERABLE DISTILLATION APPARATUS,
H. Diebel.
U.S. Patent No. 4,622,102; November 11, 1986. 7 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1072, No 2, p 661, November 11, 1986.

Descriptors: *Patents, *Distillation, *Purified water, *Domestic water, *Water treatment, Boiler water, Electrical equipment, Condensers, Water cooling.

A small, compact distiller purifies domestic water during automatic unattended operation. The distiller contains a free-standing baseplate or one that is attached to a reservoir to receive distillate, which usually is water. A boiler container containing an electric heater is mounted on a support. The support operates electric switches that open a solenoid operated valve to supply water to the boiler. The boiler output is supplied to a fan-cooled condenser coil. A float controlled switch stops the operation of the distiller when the reservoir is full. (Cremmins-AEPCO)
W88-00594

METHOD AND APPARATUS FOR CONTROLLING PRESSURE AND FLOW IN WATER DISTRIBUTION NETWORKS,
Hitachi Control Systems, Inc., Tokyo (Japan).
S. Miyaoka, T. Sekozawa, M. Funabashi, and S. Hayashi.
U.S. Patent No. 4,562,552; December 31, 1985. 7 p, 3 fig, 3 ref. Official Gazette of the United States Patent Office, Vol 1061, No 5, p 2357-2358, December 31, 1985.

Descriptors: *Patents, *Flow control, *Pressure distribution, *Control systems, *Water distribution, *Computer models, *Hydraulic models, Flow discharge, Flow regulators, Flow system, Model studies, Algorithms, Optimization, Networks, Remote control.

Pressure and flow are controlled on-line in a water distribution network based on an optimum hydraulic model. The pressure and flow controller includes a unit for computing optimally manipulated variables and one for making corrections in accordance with actual measured values. The optimum computing unit incorporates a network model simulating hydraulic phenomena within a distribution network so as to input the total demand (the sum of the reservoir outlet flow rates) and thereby compute the optimum control values by high speed computation according to a network algorithm. The correction computing unit utilizes a sensitivity matrix which indicates the effects of variations in the control values on the pressure and flow so as to correct the deviations from the estimated pressure and flow rates. (Cremmins-AEPCO)
W88-00597

PROCESS FOR THE UTILIZATION OF WASTE WATERS IN THE HYDROGENATION OF COAL,
Ruhrkohle A.G., Essen (Germany, F.R.).
For primary bibliographic entry see Field 3C.
W88-00598

METHOD AND APPARATUS FOR TREATING HYDROCARBON AND HALOGENATED HYDROCARBON CONTAMINATED GROUND AND GROUND WATER,
Groundwater Decontamination Systems, Inc., Waldwick, NJ.
For primary bibliographic entry see Field 5G.
W88-00602

MATHEMATICS FOR OPERATORS,
Michigan Dept. of Public Health, Lansing. Div. of Water Supply.
E. J. Way.
IN: Water Treatment Plant Operation Series, Volume 2, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by V. W. Langworthy. 110 p.

Descriptors: *Water treatment, *Mathematical studies, Flow velocity, Flow rate, Detention time, Settling tanks, Pumps, Efficiency, Acids, Alkalinity.

A manual on mathematics for operators of water treatment plants covers use of a calculator; decimals, fractions, and percentages; basic algebra; units and conversions (English to metric, temperature conversion); calculation of area and volumes; velocity, flow rates, and detention time; calculation of weight relationships, calculation of efficiencies (settling tanks, solid-liquid relationships, pump efficiency, output measurement); and laboratory mathematics (weight of chemical compounds, the normal system, standardizing stock acid solutions, alkalinity). The manual is intended as a guide, not a complete text. Many sample problems with answers are provided. (Cassar-PTT)
W88-00665

SYNTHETIC MEMBRANE PROCESSES: FUNDAMENTALS AND WATER APPLICATIONS.
For primary bibliographic entry see Field 3A.
W88-00700

MEMBRANE METHODS IN WATER AND WASTEWATER TREATMENT: AN OVERVIEW,
Rensselaer Polytechnic Inst., Troy, NY.
G. Belfort.
IN: Synthetic Membrane Processes: Fundamentals and Water Applications, Academic Press, Orlando, FL, 1984. p 1-19, 3 fig, 4 tab, 41 ref.

Descriptors: *Membrane processes, *Reverse osmosis, *Electrodialysis, *Ultrafiltration, Wastewater renovation, Water reuse, Desalination, Economic aspects.

The need to use unconventional sources of water (such as renovation and reuse of wastewater, and desalination of brackish water) in several semiarid regions of the world if emphasized, and the role of membrane separation processes in this area is described. Membrane processes are especially useful because they allow separation of dissolved materials from one another or from a solvent, with no phase change. The membrane processes are either pressure driven (reverse osmosis and ultrafiltration) or electrically driven (electrodialysis and transport depletion). The historical development, application and economic aspects of these processes are considered. Each process is classified according to its driving potential and range of application, and major advantages and disadvantages are described. A membrane process is defined, and the principles of membrane processes (including ideal minimum work, membranes, transport equations and coefficients, fluid mechanisms and membrane fouling) are discussed. (See also W88-00700) (Halterman-PTT)
W88-00701

HYPERFILTRATION MEMBRANES, THEIR STABILITY AND LIFE,
Atomic Energy Research Establishment, Harwell (England).
For primary bibliographic entry see Field 3A.
W88-00703

POLARIZATION PHENOMENA IN MEMBRANE PROCESSES,
Technical Univ. of Denmark, Lyngby.
For primary bibliographic entry see Field 3A.
W88-00704

MATHEMATICAL MODELING OF FLUID FLOW AND SOLUTE DISTRIBUTION IN PRESSURE-DRIVEN MEMBRANE MODULES,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 3A.
W88-00705

ELECTRODIALYSIS - MEMBRANES AND MASS TRANSPORT,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Applied Research Inst.
For primary bibliographic entry see Field 3A.
W88-00706

DESALTING EXPERIENCE BY HYPERFILTRATION (REVERSE OSMOSIS) IN THE UNITED STATES,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 3A.
W88-00707

DESALTING EXPERIENCE USING HYPERFILTRATION IN EUROPE AND JAPAN,
Gesamthochschule Essen (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-00708

WATER AND WASTEWATER TREATMENT EXPERIENCE IN EUROPE AND JAPAN USING ULTRAFILTRATION,
Fraunhofer-Inst. fuer Grenzflaechen- und Bioverfahrenstechnik, Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-00709

DESIGN AND OPERATION OF DESALTING SYSTEMS BASED ON MEMBRANE PROCESSES,
Bechtel Corp., San Francisco, CA.
For primary bibliographic entry see Field 3A.
W88-00711

ECONOMICS OF THE APPLICATION OF MEMBRANE PROCESSES; PART I: DESALTING BRACKISH AND SEAWATERS,
Mekoroth Water Co., Tel-Aviv (Israel).
For primary bibliographic entry see Field 3A.
W88-00712

PHOTOLYTIC OZONATION FOR PROTECTION AND REHABILITATION OF GROUNDWATER RESOURCES; A MECHANISTICS STUDY,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
For primary bibliographic entry see Field 5D.
W88-00727

FINANCING WATER SUPPLY AND WASTEWATER SERVICES IN NORTH CAROLINA IN THE 1980S,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 5D.
W88-00735

CATION-EXCHANGE PRETREATMENT STUDIES FOR LAVERKIN SPRINGS,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
For primary bibliographic entry see Field 3A.
W88-00777

DESIGN, CONSTRUCTION AND OPERATION OF LENOX WATER TREATMENT PLANT, LENOX, MASSACHUSETTS, U.S.A: PROJECT SUMMARY,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-171264. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No KEC/01-83/1, January 19, 1983. 38 p, 1 fig, 4 tab, 15 exhibits.

Descriptors: *Water treatment, *Chemical treatment, *Flotation, *Performance evaluation, *Flocculation, Separation techniques, Design criteria, Water treatment facilities, Disinfection, Chemical precipitation, Filtration, Clarification.

The heart of the Lenox Water Treatment Plant is the SANDFLOAT package plant consisting of chemical feeding, flocculation, dissolved air flotation, and automatic backwash filtration. The plant was designed in October 1981 and constructed in May 1982 by Krofta Engineering Corporation. In this report, the Lenox water resources system, water quality, SANDFLOAT plant design and construction are introduced, and the start-up and operational data from May 21, 1982 to January 9, 1983 are summarized. The newly developed SANDFLOAT plant is the first full-scale potable flotation plant ever built in America. The only difference between the SANDFLOAT Plant and a conventional water treatment plant is the clarifiers used for separation of alum flocs (or alum-polymer flocs) from the flocculation water. The SANDFLOAT plant uses dissolved air flotation clarifier (with up to only 5.5 minutes detention time) in comparison with a conventional plant using sedimentation clarifier (with 2-3 hr detention time). Based on the operational data generated so far, the SANDFLOAT package plant has been proven to be a feasible system for water purification. The system is economically feasible for adoption by small communities. (See also W88-00853) (Geiger-PTT)
W88-00852

DESIGN, CONSTRUCTION AND OPERATION OF LENOX WATER TREATMENT PLANT, LENOX, MASSACHUSETTS, U.S.A: PROJECT DOCUMENTATION, PART 1,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-164731. Price codes: A15 in paper copy, A01 in microfiche. Technical Report KEC/01-83/3, January 26, 1983. 330 p, 225 tab, 17 ref, 19 append.

Descriptors: *Performance evaluation, *Water treatment, *Water treatment facilities, *Chemical treatment, *Flotation, Water supply, Design criteria, Filtration, Coliforms, Organic compounds, Potable water, Drinking water, Turbidity, Color.

This report is one of three documents presenting important engineering data for the Lenox Water Treatment plant from May 21, 1982 (its start-up day) to January 12, 1983. The Lenox Water Treatment PLant is the first full-scale (1 MGD) potable flotation plant built in America. The treatment plant consists of chemical flocculation, dissolved air flotation and automatic backwash filtration. It has been serving about 6500 residents in the Town of Lenox, Massachusetts since July 1982. The plant effluent has always met the U.S. Environmental Protection Agency Drinking Water Standards for turbidity, pH, and color. This technical report fully documents: the daily, weekly, and monthly operational data; chemical treatment data; removal data on total coliforms, volatile organics, turbidity, and color; down time records; sludge generation and characteristics; important analytical procedures; plant operational procedures; important correspondence and communications; and the present U. S. Environmental Protection Agency and Massachusetts Drinking Water Standards. (See also W88-00852) (Geiger-PTT)
W88-00853

INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE: REVIEW OF NATIONAL BASELINE DATA (AS AT 31 DECEMBER 1980).
World Health Organization, Geneva (Switzerland).
WHO Offset Publication No. 85, 1984. 169 p, 13 fig, 63 tab, append.

Descriptors: *Water quality, *Water supply, *Water pollution effects, *Sanitation, *Water requirements, *Baseline studies, *Sanitary wastewater, Africa, Americas, Southeast Asia, Europe, Eastern Mediterranean, Western Pacific.

Widespread concern to insure water and sanitary disposal for communities, households, and individuals all over the world, especially in developing countries, led to the designation of the current decade (1981-1990) by the United Nations General Assembly as the International Drinking Water and Sanitation Decade. International organizations and other external support agencies were requested to identify their cooperation with developing countries in planning, conducting, and monitoring water supply and sanitation programs. The purpose of this report is to present the baseline data for the beginning of the decade. Progress will be assessed by comparing information at the end of the decade with the data in this report. The data are presented by region, mainly Africa, the Americas, Southeast Asia, Europe, Eastern Mediterranean, and the Western Pacific, and a global summary is provided. Each of the summaries contains data on the level of water and sanitation service, indicators of needs for improving services, goals for improving services, population coverages, staffing requirements for improved services, and constraints expected to impair the achievement of projected goals. Conclusions drawn include the necessity of doubling water supply and sanitary disposal services in some areas and that funding and trained personnel are the major constraints to achieving the goals of the program. (Halterman-PTT)
W88-00878

PROCESS DYNAMICS, CONTROL AND PROTECTION,
B. Roffel, and J. E. Rijnsdorp.
Ann Arbor Science, Ann Arbor, MI. 1982. 415 p.

Descriptors: *Water treatment, *Wastewater treatment, *Process control, *Control systems, Model studies, Mathematical studies, Water level, Flow control, Valves, Heat transfer, Cooling water, Biological wastewater treatment, Activated sludge process, Distillation, Fate of pollutants, Tubular flow, Catalysts, Quality control, Hydraulics, Differential equations, Protection, Hydrodynamics.

This approach to control theory uses generally known and used mathematical approaches to process dynamics rather than specialized mathematical techniques such as the Laplace transform. Straightforward operational notations (linked to linear differential equations) and physical interpretation of mathematical results are featured. Categories discussed are process modeling, distributed systems, approximation of the solution of partial differential equations, control quality, development of control systems, and process protection. Specific topics related to water and wastewater include level control, valves and pipelines (flow control), heat transfer control, control of continuous flow reactors, control of biological reactors, distillation, heat exchange, river pollution, tubular flow bioreactors, and control quality. (Cassar-PTT)
W88-00880

5G. Water Quality Control

LARGE DATA BASES AND REGIONAL GROUND-WATER QUALITY ASSESSMENTS - AN IOWA CASE STUDY,
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 7C.
W88-00015

IRRIGATION CONTROL IN THE PRESENCE OF SALINITY: EXTENDED LINEAR QUADRATIC APPROACH,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W88-00027

OPTIMAL GROUNDWATER QUALITY MANAGEMENT UNDER PARAMETER UNCERTAINTY,
Geological Survey, Menlo Park, CA. Water Resources Div.
B. J. Wagner, and S. M. Gorelick.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1162-1174, July 1987. 8 fig, 5 tab, 43 ref.

Descriptors: *Water quality control, *Water quality management, *Groundwater management, *Aquifer remediation, *Aquifer management, *Model studies, *Data interpretation, Mathematical equations, Parameter estimation, Simulation, Design standards, Design criteria, Water quality.

Optimization models for groundwater quality management give no assurance that water quality standards will be met. This is in part because they ignore errors in hydraulic heads, flows, and solute concentrations due to flow and transport model parameter uncertainty. Parameter estimation and estimate uncertainties were explicitly incorporated into a model for the optimal design of an aquifer remediation scheme. Parameter uncertainty was incorporated into the decision-making process. The objective is to identify the best remediation strategies (well site selection and pumping-recharge rates) so that water quality standards would be met at a specified reliability level. The procedure couples three methods: (1) a finite element flow and transport simulation model combined with nonlinear least squares multiple regression for simultaneous flow and transport parameter estimation; (2) first-order first- and second-moment analysis to transfer the information about the effects of parameter uncertainty to the management model; and (3) nonlinear chance-constrained stochastic optimization combined with flow and transport simulation for optimal decision-making. This joint approach enables one to estimate the unknown aquifer parameters, quantify the uncertainty of the parameter estimates, simulate flow and transport responses, and automatically account for parameter uncertainty in the decision-making process through the simulation management model. Results show that remediation requirements can increase dramatically due to parameter uncertainty. Risk-averse design solutions automatically provide insurance by 'overdesigning' the strategy relative to the risk-neutral case. The approach is fairly general and is applicable to a variety of groundwater management problems. The influence on design solutions of the reliability level and verification of the underlying statistical assumptions of the first-order analysis were explored in a sensitivity study and 2000 Monte Carlo simulations, respectively. (Author's abstract)
W88-00028

LEGAL AND INSTITUTIONAL CONSIDERATIONS IN WATER REUSE,
Denver Research Inst., CO. Industrial Economics Div.
L. C. Lohman.
In: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 31-54, 16 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Water law, Waste management, Waste recovery, Wastewater, Wastewater management, Wastewater renovation, Legal aspects, Regulations, State jurisdiction, Water rights.

The hydrologic connection of water within a river basin can involve states, regions, and even the nation as the water flow crosses state or natural boundaries. A clear understanding of this concept is necessary before one can properly envisage the legal and institutional factors that shape any deliberate reuse of water in the United States. This paper focuses on the legal and institutional considerations that affect a planned reuse of water. The legal factors generally flow downward from federal to state, region or town. Elements of federal control include the National Water Pollution Control Act, the National Pollution Discharge Elimination System permits, the National Environmental Policy Act, and the Safe Drinking Water Act. Many states oversee all aspects of wastewater treatment, reclamation, and permissible reuse. The technical difficulty of distinguishing legal from institutional considerations is discussed. Also discussed is the fact that the matter is further complicated by the ubiquitous nature of the legal, personal, political and social factors influencing institutional activity, which precludes precise, empirical analysis. (See also W88-00164) (Halterman-PTT)
W88-00166

INFLUENCE OF SOCIAL FACTORS ON PUBLIC ACCEPTANCE OF RENOVATED WASTEWATER,
California Univ., Irvine. Program in Social Ecology.
For primary bibliographic entry see Field 6D.
W88-00167

FEDERAL INCENTIVES AND REQUIREMENTS INFLUENCING WASTEWATER REUSE,
Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
R. E. Thomas.
IN: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 75-86, 13 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Waste management, Wastewater, Wastewater irrigation, Wastewater farming, Wastewater renovation, Legal aspects, Water law.

Wastewater reuse is an issue that is continually growing in importance. This paper presents an overview of guidelines applicable to reuse of municipal wastewaters as mandated by recent federal law, and the U.S. Environmental Protection Agency's extension of this mandate into federal guidance for management of the EPA Construction Grants program. Historically, the earliest legislation did nothing to encourage wastewater reuse. The Federal Water Pollution Control Act of 1956 was, however, the turning point. It contained a modest construction grants program which included support for research and development of new technologies. Recent research and demonstration projects are rapidly advancing the knowledge 68 reuse of wastewaters in agriculture, silviculture and aquaculture. Finally, the EPA has issued a series of guidance documents to encourage proven and developing wastewater management technologies which include reuse. (See also W88-00137) (Halterman-PTT)
W88-00168

ENVIRONMENTAL POLLUTION AND CONTROL,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-00330

NONPOINT SOURCE WATER POLLUTION,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-00336

HAZARDOUS WASTE,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-00338

ASSESSING THE EFFECTS OF COAL MINING AND RELATED ENERGY DEVELOPMENT ON AQUATIC ENVIRONMENTAL QUALITY IN THE UPPER COLORADO BASIN,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 4C.
W88-00356

USE OF HYDROELECTRIC DAMS TO CONTROL EVAPORATION AND SALINITY IN THE COLORADO RIVER SYSTEM,
Nevada Univ., Las Vegas.
For primary bibliographic entry see Field 3B.
W88-00359

EFFECTS OF IMPROVEMENTS ON SALINITY IN THE COLORADO RIVER,
Nevada Univ., Las Vegas.
For primary bibliographic entry see Field 6G.
W88-00360

NATURAL SALINITY REMOVAL IN MAINSTEM RESERVOIR: MECHANISMS, OCCURRENCE, AND WATER RESOURCES IMPACTS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2K.
W88-00362

ARTIFICIAL WIND POWERED CIRCULATION OF HIGH MOUNTAIN LAKES OF THE UINTAS,
Wasatch-Cache National Forest, Salt Lake City, UT.
For primary bibliographic entry see Field 8I.
W88-00367

MAINTAINING SAFE WATER SUPPLIES,
M. N. Sara.
IN: Ground Water 82: Programme and Extended Abstracts, 1982. p 60-71, 2 fig, 6 tab, 3 ref.

Descriptors: *Water qaulity control, *Wells, Public health, Diseases, Pathogens, Fate of pollutants, Rural areas, Water supply.

Wells must be protected from pollution by preventing surface water from entering certain places: the top of the well, the well below ground level, and the space between the well casing and the soil around it. This can be accomplished by extending the casing or sleve 20 to 80 cm above ground level, by building up the ground around the well so it slopes from the well in all directions, and by sealing around the well casing with cement. Other helpful measures include a sanitary well seal, a diversion ditch 15 m uphill from the well and keeping livestock at least 30 m distant. (See also W88-00373) (Cassar-PTT)
W88-00394

EFFECTIVENESS OF A EUROPEAN SURFACE WATER TREATMENT SYSTEM, ESPECIALLY IN REMOVAL OF ORGANICS,
For primary bibliographic entry see Field 5F.
W88-00455

RAFT RIVER MONITOR WELL POTENTIOMETRIC HEAD RESPONSES AND WATER QUALITY AS RELATED TO THE CONCEPTUAL GROUND-WATER FLOW SYSTEM,
EG and G Idaho, Inc., Idaho Falls.
For primary bibliographic entry see Field 4B.
W88-00473

COMBUSTION OF OIL ON WATER: AN EXPERIMENTAL PROGRAM,
Battelle Pacific Northwest Labs., Richland, WA.
W. Wakamiya, S. E. Petty, A. Boiarski, and A. Putnam.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-014598. Price codes: A05 in paper copy, A01 in microfiche. DOE/NBM/1002, February 1982. 102 p, 16 fig, 10 tab, 24 ref, 4 append.

Descriptors: *Water quality control, *Oil spills, *Burning, *Cleanup operations, Cold regions, Oil, Evaporation, Oily water.

Nine oils commonly transported on major waterways were burned on water under warm weather conditions (30 C) and cold weather conditions (0-10 C). On the average, 90% of each oil sampled burned. The surface temperature of the oils remained relatively constant at 220 C throughout the fire. This indicates an equilibrium flash vaporization mechanism. Combustion ceased when the energy passing the oil/water interface approximated the energy radiated from the flame back to surface of the oil slick. This occurred when the thickness of the oil layer became less than 3 mm. Adding heat to the oil did not significantly increase the burning rates. However, it did improve ease of ignition. The heavier oils, diesel and Bunker V fuel oils, did not burn without the addition of gasoline, wood chips, or methanol. The proportion of oil burned was significantly higher than the 35-72% predicted by the Thompson oil-burning model. Distillation was not a factor in combustion of crude oils as evidenced by the constant 220 C surface temperature and the presence of light ends in the oil residual. Burning rates were less at cold temperatures. (Cassar-PTT)
W88-00486

METHOD AND APPARATUS FOR TREATING THE SURFACE OF A BODY OF LIQUID,
Solmat Systems Ltd., Yavne (Israel).
N. Lahav.
U.S. Patent No. 4,455,226; June 19, 1984. 6 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1043, No 3, p 1143, June 19, 1984.

Descriptors: *Patents, *Solar energy, *Evaporation, *Oil, *Surfactants, *Ponds, *Surface water, Solar radiation, Marine climates, Particulate matter, Cleaning, Waves.

Oil is applied to a body of water, or solar pond, to reduce evaporation, inhibit wave formation, and clean dust and other particles from the surface. Oil treatment equipment includes wind-activated nozzles for applying the oil at an upwind peripheral location, a trough for collecting it at a downwind peripheral location, a filter for purifying the collected oil, color and spreadability sensors for examining it, and a device for controlling the quality of the collected oil in accordance with the sensor output. A pump and pipe recirculate the treated oil from the trough to the nozzels. (Cremmins-AEPCO)
W88-00496

POND WITH FILTERED WATER,
Komarom Megyai Tanacsi Tervezo Iroda, Esztergom (Hungary).
For primary bibliographic entry see Field 5F.
W88-00501

MARINE CIRCULATOR,
M. A. Liscio.
U.S. Patent No. 4,439,060; March 27, 1984. 5 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1040, No 4, p 1577-1578, March 27, 1984.

Descriptors: *Patents, *Ice-water interfaces, *Ice formation, *Water circulation, *Freezing, *Bottom water, *Water currents, Surface water, Marine environment, Bottom currents, Docks, Damage, Oil slicks, Aeration.

A marine circulator directs warmer lake, pond, or river bottom water upward toward colder surface water to prevent ice from forming during freezing weather. The housing of the circulator is open at the top and closed at the bottom with either tapered or rounded bottom edges so that when it is submerged the container will assume an inclined position resting upon a portion of the tapered or rounded edge. Openings are formed around the circumference of the housing above and in the proximity to the tapered or rounded area to permit water to be drawn into the housing by a motor which rotates a fan or propeller blade. The housing bottom is provided with a flat area to permit it to assume a vertical position for either use or storage. The marine circulator propels or moves water so as to push debris or oil slicks. It may also be disposed at the bottom of a body of water to circulate it without disturbing the bottom or sucking up bottom materials. The device may also be used for aerating water to encourage marine growth or for circulating it to prevent the growth of marine life. (Cremmins-AEPCO)
W88-00502

METHOD OF STORING LOGS,
British Columbia Research Council, Vancouver.
For primary bibliographic entry see Field 6 .
W88-00507

MOISTURE IMPERVIENT BARRIER AND METHOD FOR MAKING SAME,
L. A. Crawford.
U.S. Patent No. 4,615,809; October 7, 1986. 6 p, 3

fig, 11 tab, 1 ref. Official Gazette of the United States Patent Office, Vol 1071, No 1, p 272-273, October 7, 1986.

Descriptors: *Patents, *Moisture, *Barriers, *Impervious boundaries, *Waterproofing, *Water pollution control, *Water pollution prevention, *Impervient barriers, Permeability, Bentonite, Seepage control, Leaching.

This moisture impervient barrier prevents the seepage of water and the leaching of contaminants from ponds, reservoirs, dams, municipal and industrial waste lagoons, and burial sites. The barrier comprises a flexible base sheet, containing an upper surface, a lower surface and a longitudinial axis, and is constructed of material which is gas permeable in any direction within the plane defined by the base sheet member so as to permit gas escape. The barrier also contains a layer of water swellable bentonite resting on the base sheet, an elongated flexible top sheet resting on this layer, and a securing means comprising thread stitches extending through the base sheet, the bentonite, and the top sheet. The stitches divide the spaced base and top sheet members into a quilted pattern forming four sided compartments, each containing a portion of bentonite. (Cremmins-AEPCO)
W88-00509

BILGE SYSTEM,
Texas Oil Spill Control, Inc., Conroe.
T. R. Rymal.
U.S. Patent No. 4,492,630; January 8, 1985. 4 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1050, No 2, p 647, January 8, 1985.

Descriptors: *Wastewater treatment, *Water pollution control, *Patents, *Separation techniques, *Bilge, *Oily water, *Water tanks, Pumps, Vacuum filtration, Baffles, Hydrocarbons, Floating, Vacuum pumps, Portable equipment.

This portable oil/water separator and pump system can be used to collect hydrocarbons from a body of water such as a bilge. The separator includes a housing forming a pair of tanks connected by a passageway. The oil/water mixture inlet directs the liquid into one tank which is connected between its ends to the passageway. The connection may include, for example, a pair of check valves to allow the flow of liquid into the passageway, but not from the passageways back into the first tank. Baffles are mounted in the passageway to separate oil and water before it flows into the middle of the second tank. An oil outlet is connected to the top portion and an overflow water outlet is connected to the bottom portion of the second tank. The inlet of the oil/water separator is connected to the pump which has a hose, or other suitable apparatus, to connect it to the oil/water mixture. The apparatus can be manufactured in miniature to permit portability. (Cremmins-AEPCO)
W88-00513

UNDERGROUND LEACHATE BARRIER AND METHOD OF MAKING SAME,
For primary bibliographic entry see Field 5E.
W88-00514

PORTABLE METHOD FOR DECONTAMINATION,
KBI Corp., Findlay, OH.
J. L. Kirt, and R. J. Ohneck.
U.S. Patent No. 4,435,292; March 6, 1984. 8 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1040, No 1, p 283, March 6, 1984.

Descriptors: *Patents, *Decontamination, *Clean-up, *Soil contamination, *Groundwater pollution, *Pipes, *Water pollution control, Fluid, Flushing, Soil treatment, Wells.

Soils, ground and groundwater contaminated by spills are decontaminated using a closed or self-contained and therefore reversible apparatus. The contaminant is contained and confined within a given area. Small amounts of flushing or treating fluid are used to remove the contaminants, thus obviating the need to dispose of large volumes of contaminated material and/or undesirable chemicals. The area is tested to determine the boundaries of the contamination, and closely spaced perforated pipes are inserted around and into the soil below the contaminated area. A flushing fluid under positive pressure is circulated into the pipes around the contaminated area, while simultaneously under negative pressure removing the fluid containing contaminants from the pipe. The decontaminated flushing fluid is injected back into the soil under the positive pressure to maintain the closed fluid circulating system. (Cremmins-AEPCO)
W88-00522

SURFACE-ACTIVATED COMPOSITIONS AND METHOD FOR DISPERSING OIL SLICKS,
Cosen Technology, Inc., Dallas, TX.
A. Lepain, and A. G. R. Charlier.
U.S. Patent No. 4,469,603; September 4, 1984. 6 p, 4 tab. Official Gazette of the United States Patent Office, Vol 1046, No 1, p 281, September 4, 1984.

Descriptors: *Patents, *Dispersants, *Surfactants, *Cleanup operations, *Oil slicks, *Water pollution control, *Seawater, Oil spills, Water pollution sources, Solvents, Oil, Oily water, Oil pollution, Fatty acids, Spraying.

Oil slicks on seawater are treated and dispersed by spraying a surface-active composition. The composition consists essentially of about 70 to 75 weight percent of a blend of oleic acid sorbitan monoester, a polyethylene oxide adduct of oleic acid sorbitan monoester and a 75% aqueous solution of di(ethylhexyl)sulfosuccinate sodium salt. The weight percentage of the salt, based on dry salt and dry blend, is from 35 to 40% and the weight ratio of oleic acid sorbitan monoester to its polyethylene oxide adduct is about 55:45. The blend has a hydrophilic-lipophilic balance from about 9 to about 10.5 and from about 30 to 25 weight percent of a hydrocarbon free solvent mixture of water and a monoalkylether of a glycol, diethylene glycol, monopropylene glycol and dipropylene glycol. The alkyl radical contains from 1 to 4 carbon atoms, the total amount of water in the composition is 20 to 27.5 weight percent, and the composition has a viscosity or from about 475 to 575 centistokes at -10 C. (Cremmins-AEPCO)
W88-00523

APPARATUS FOR EQUALIZATION OF OVERFLOW WATER AND URBAN RUNOFF IN RECEIVING BODIES OF WATER,
Munters Corp., Fort Myers, FL.
K. R. Dunkers.
U.S. Patent No. 4,377,477; March 22, 1983. 7 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1028, No 4, p 831, March 22, 1983.

Descriptors: *Patents, *Equalizing basins, *Overflow, *Water pollution treatment, *Lake basins, *Urban runoff, *Water tanks, Storm runoff, Flow control, Pressure distribution, Stormwater, Water pollution sources, Pumps.

Overflow water and urban runoff are equalized in a lake or other receiving body of water using a series of compartments. Each compartment is formed by walls placed in the water substantially from its surface to its bottom. The compartments are in communication with each other in sequence. The first compartment is connected to an inlet for overflow water or urban runoff, and the last compartment is in communication with the surrounding water. The first compartment is suitably made so that it can serve as a separation area for oil and scum, and has a pump for taking water from it to a treatment plant, from which the treated water is led to the receiving body of water outside the equalization tank. (Cremmins-AEPCO)
W88-00524

METHOD OF REMOVING WATER FROM EARTHEN PITS,
S and A Oil Field Service, Inc., Fort Cobb, OK.
S. C. Horn, and A. A. Mogg.
U.S. Patent No. 4,449,849; May 22, 1984. 6 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1042, No 14, p 1588, May 22, 1984.

Descriptors: *Patents, *Earth-water interfaces, *Evacation, *Spraying, *Evaporation, *Pumping, *Drilling fluids, Pumps, Nozzles, Oil recovery, Oil wells, Gas wells, Earthen pits.

Water is removed from an earthen pit by placing spray nozzles around the periphery of the pit. The nozzles are directed towards the center of the pit, and water is pumped from the pit through the nozzles. The water is sprayed towards the center of the pit and removed by evaporation. Associated with this method is the removal of an earthen pit containing an aqueous well drilling fluid. (Cremmins-AEPCO)
W88-00525

FLUID TRANSPORT AND PROCESSING SYSTEM,
F. W. Kantor.
U.S. Patent No. 4,618,421; October 21, 1986. 26 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1071, No 3, p 1199, October 21, 1986.

Descriptors: *Patents, *Water pollution control, *Fluid flow, *Water conveyance, *Water transport, *Conduits, *Wastewater treatment, Thin walls, Tubes, Equilibrium, Waste disposal.

Water pollution control and fresh water transport are achieved using a thin wall main conduit in fluid equilibrium on or near the bottom of a body of water. Inlet conduits convey liquids into the main conduit from positions spaced along an artery, which empties into a larger body of water. A merge system couples the inlet conduits with the main conduit to feed liquid wastes into it. A pump augments the flow of liquid waste in one direction through the conduit without causing substantial departure from said pressure equilibrium for achieving dynamic stability of the flow. One disposal arrangement is a conventional on-shore processing plant; another is a deep-water disposal site; and a third is a floating or underwater processing plant, either on the bottom of the river, ocean or lake, or floating on the surface of such a body of water. Alternatively, the wastes can be processed in transit in the tubes. (Cremmins-AEPCO)
W88-00528

BLOWOUT RECOVERY SYSTEM,
T. Miller.
U.S. Patent No. 4,382,716; May 10, 1983. 11 p, 7 fig. Official Gazette of the United States Patent Office, Vol 1030, No 2, p 411-412, May 10, 1983.

Descriptors: *Patents, *Blowouts, *Effluents, *Underwater, *Oil wells, *Oil recovery, Water pollution prevention, *Water pollution control, Buoyancy, Cleanup operations, Submergence, Flotation, Water tanks, Separation techniques, Storage tanks, Entrapment.

Effluent discharged from a damaged or inoperative underwater oil well is entrapped and recovered for processing to minimize environmental pollution. A submergeable vehicle is trailed behind and towed by a surface vessel, which has buoyancy adjustment means to raise or lower the vehicle to vertically position it with respect to an underwater blowout. The vehicle includes a hollow effluent entrapment shell of generally conical configuration, which is open at the bottom and is positioned cap-like over an underwater well. The effluent entrapment shell is connected to a vertically extending main spinal tube, which communicates on its lower end with the upper portion of the interior of the shell and extends vertically with radial outflow tubes. Canted brace tubes and the spinal tube are connected by hose to floating separation equipment on a barge or the like on the surface of the body of water in which the well is located. Buoyancy tank members are coaxially mounted on and around the spinal tube, the radial outflow tubes, and the canted brace tubes. Air lines extending to the surface provide compressed air to the buoyancy tanks to permit the expelling of the water in the tanks through outlet openings for buoyancy. (Cremmins-AEPCO)

W88-00529

CHROMIUM VALENCY RESPONSE AND ENVIRONMENTAL FATE IN THREE-PHASE AQUATIC MICROCOSMS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5B.
W88-00547

CHEMICAL DISPERSANT FOR VISCOUS OILS,
Exxon Research and Engineering Co., Florham Park, NJ.
G. P. Canevari.
U.S. Patent No. 4,560,482; December 24, 1985. Official Gazette of the United States Patent Office, Vol 1061, No 4, p 1658, December 24, 1985.

Descriptors: *Patents, *Dispersants, *Oil slicks, *Water pollution control, Oil-spills, Polymers, Surfactants, Viscosity, Oil-water interfaces.

A chemical composition disperses oils having compositions of about 1,000 to 10,000 centipoise in water. The composition consists essentially of a non-ionic surfactant, a polymeric agent and a petroleum oil in a ratio whereby the composition has a sticky gel-like consistency and a viscosity of at least 10% of the viscosity of the oil to be dispersed. The polymeric agent is selected from the group consisting of polyisobutylene, ethylene-propylene copolymers, polydimethyl siloxane, polypropylene oxide, cispolyisoprene, cis-polybutadiene and polystyrene. The surfactant is selected from polyoxyethylene sorbitan fatty acids esters. (Cremmins-AEPCO)
W88-00568

METHOD FOR TREATING THE UPPER LAYER OF A BODY OF WATER,
A. A. Green, and R. H. Black.
U.S. Patent No. 4,518,506; May 21, 1985. 5 p. Official Gazette of the United States Patent Office, Vol 1054, No 3, p 1270, May 21, 1985.

Descriptors: *Patents, *Oil spills, *Silicates, *Water pollution control, *Bactericides, Cleanup operations, Oil slicks, Solvents, Hydrogen ion concentration, Plant growth substances, Oil pollution.

The upper layer of a body of water is treated, especially to remove spilled oil, using an expanded silicate aggregate and at least one treating agent. Sodium silicate is impregnated with up to about 95% by weight of one or more bactericides. The composition floats on the upper layer of a body of water until chemical and physical changes occur. The expanded silicate has a density of about 1.5 to 30, typically from about 1.7 to about 5 pounds/cu ft. Besides removing spilled oil the composition can also be used to change the pH of the water or to control plant growth. (Cremmins-AEPCO)
W88-00569

METHOD FOR TREATING OIL SLICKS,
Labofina S.A., Brussels (Belgium).
A. Lepain, and R. D. Bronchart.
U.S. Patent No. 4,623,468; November 18, 1986. 5 p. Official Gazette of the United States Patent Office, Vol 1072, No 3, p 1147, November 18, 1986.

Descriptors: *Patents, *Surfactants, *Dispersants, *Oil slicks, *Water pollution control, *Biodegradation, *Seawater, Oil pollution, Solvents, Nitrogen, Nutrients, Spraying, Hydrocarbons, Oil spills.

Oil slicks on seawater are dispersed into oil droplets and biodegraded by microorganisms using a composition comprising at least one surfactant and solvent, and a monoalkylguanidium salt, which acts as a source of oleophilic, nitrogen containing nutrient. The solvent comprises a liquid hydrocarbon containing less than 5% of aromatic compounds and less than 50% water. The nitrogen containing compound comprises an aliphatic hydrocarbon radical, saturated or unsaturated, containing about 8 to 20 carbon atoms, and a halogen or acid anion. The dispersants may be used without water or after dilution by water. They may be sprayed on the oil slicks from aircraft or from boats. (Cremmins-AEPCO)
W88-00570

HYDROCARBON SOLVENT-BASED DISPERSANT FORMULATION AND ITS USE IN THE DISPERSION OF VISCOUS OIL SPILLS,
Exxon Research and Engineering Co., Florham Park, NJ.
K. W. Becker, J. R. Jackson, G. P. Lindblom, and M. A. Walsh.
U.S. Patent No. 4,502,962; March 5, 1985. 4 p. Official Gazette of the United States Patent Office, Vol 1052, No 1, p 288, March 5, 1985.

Descriptors: *Patents, *Oil spills, *Hydrocarbons, *Dispersants, *Solvents, *Water pollution prevention, Oil slicks, Viscosity, Saltwater, Natural waters, Spraying, Oil pollution.

Highly viscous oil spills on fresh or salt water are dispersed by aerially spraying a hydrocarbon solvent-based formulation. The formulation comprises a sorbitan monoester of a C10-C20 aliphatic monocarboxylic acid; a polyoxyalkylene adduct of a sorbitan monoester of a C10-C20 aliphatic monocarboxylic acid, having 6 to 30 polyoxyalkylene units per mole of monoester; a polyoxyalkylene adduct of a sorbitan triester of a C10-C20 aliphatic monocarboxylic acid, having 6 to 30 polyoxyalkyene units per mole of triester; an anionic surfactant, having a critical micelle concentration (at 25 C) of 0.0005 to 0.005 grams/100 ml.; and 15 to 40, preferably 20 to 35, weight percent of an isoparaffinic hydrocarbon solvent. The dispersant composition can be applied to the oil slick either alone or in conjunction with an additional suitable solvent or diluent. Highly desirable results are achieved by spraying the dispersant system directly and uniformly onto the surface of the oil slick, using approximately 1 part by volume of dispersant per 15 to 50 parts by volume of oil. It is ordinarily not necessary to mechanically agitate the treated oil slick in order to achieve effective dispersion, since normal wind and wave energy present at the sea surface will be adequate to cause breakup of the slick. (Cremmins-AEPCO)
W88-00571

METHOD AND APPARATUS FOR REMOVING CONTAMINANTS FROM SOIL,
Foster Wheeler Corp., Livingston, NJ.
R. J. Russomano.
U.S. Patent No. 4,611,950; September 6, 1986. 7 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1070, No 3, p 1166, September 16, 1986.

Descriptors: *Patents, *Water pollution control, *Cleanup, *Decontamination, *Groundwater pollution, *Soil contamination, Conduits, Water circulation, Pumping, Spraying, Nozzles.

Soil contaminants are removed by circulating water through a two conduit system in the area of the soil to be decontaminated. Water discharged from the first conduit, using at least one spray nozzle, enters the soil and mixes with the contaminants. This water and contaminant mixture is removed from the soil in response to the flow of water in the second conduit. The latter conduit contains a venturi comprising an eductor and perforated tube to reduce the pressure in the conduit. The mixed water and contaminants travel through the soil to a set of vertical inlet risers positioned in the soil and located at a distance from the spray nozzles. The water-contaminant mixture is drawn through the inlet risers via a collection conduit system to a holding tank from which the water is taken for removal of the contaminants. The water is drawn through the inlet risers by producing a high velocity stream of water using a venturi device and passing the stream over the upper end of the removal conduit. The vacuum created by the high velocity stream causes the water in the inlet riser to flow into the removal conduit system. (Cremmins-AEPCO)
W88-00582

METHOD FOR CONSTRUCTING A SCREEN THAT OBSTRUCTS THE FLOW OF SUBSOIL WATER,
Stevin Construction Inc., Dover, DE.
For primary bibliographic entry see Field 4B.
W88-00583

UNDERGROUND LEACHATE BARRIER AND METHOD OF MAKING SAME,
G. R. Tallard.
U.S. Patent No. 4,543,016; September 24, 1985. 5 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1058, No 4, p 1655, September 24, 1985.

Descriptors: *Patents, *Leachates, *Barriers, *Slurries, *Trenches, *Impervious membranes, *Hazardous materials, Migration, Subsurface drainage, Drainage ditches, Biodegradation, Excavation, Plug flow, Soil contamination.

A subterranean barrier isolates hazardous leachates using a trench excavated under biodegradable slurry. A liquid impervious membrane is placed along a wall of the trench, which is sealed along the length of its lower edge by an impervious plug formed on the bottom of the trench. A drain pipe with monitoring risers is positioned in the slurry after which the trench and slurry are backfired with filter gravel. The resultant barrier stops possible migration of the leachate out of the boundaries of the site and enables leachate entering the porous filter gravel and fermented biodegradable slurry mixtures to be collected in the drain pipe and pumped out through a riser pipe or at a low point pumping station for safe above-ground treatment and disposal. (Cremmins-AEPCO)
W88-00585

METHOD AND APPARATUS FOR IMPEDING SEDIMENT DEPOSITION IN HARBORS AND NAVIGATION CHANNELS,
California Univ., Berkeley. Regents.
For primary bibliographic entry see Field 8H.
W88-00586

METHOD AND APPARATUS FOR PRE-DILUTION OF DRILLING MUD AND SLURRY AND THE LIKE,
Atlantic Richfield Co., Los Angeles, CA.
For primary bibliographic entry see Field 5D.
W88-00588

METHOD FOR REMOVING SLUDGE OR MUD FROM THE BOTTOM OF A WATER AREA,
R. N. van Weezenbeek.
U.S. Patent No. 4,604,000; August 5, 1986. 7 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1069, No 1, p 214, August 5, 1986.

Descriptors: *Patents, *Mud-water interfaces, *Dredging, *Sediment control, *Bottom water, *Jets, *Water pollution control, Mudflows, Mud, Nozzles, Flow discharge, Pumping.

Water jets remove mud layers on the bottom of water areas in which flow is slight or absent. Water from jet nozzles inserted directly into the mud layers is transformed into a thick liquified state such that the liquified mud substance begins to flow. The mud flows to a level lower than the upper limit of the mud layer, preferably at the level of the original bottom or lower. The flow results from the difference in specific mass in relation to the water. At the lower level the mud is removed by a pump or through river flow. (Cremmins-AEPCO)
W88-00590

METHOD AND APPARATUS FOR TREATING HYDROCARBON AND HALOGENATED HYDROCARBON CONTAMINATED GROUND AND GROUND WATER,
Groundwater Decontamination Systems, Inc., Waldwick, NJ.
V. Jhaveri, A. J. Mazzacca, and H. Snyder.

U.S. Patent No. 4,401,569; August 30, 1983. 11 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1033, No 5, p 1991-1992, August 30, 1983.

Descriptors: *Patents, *Water pollution treatment, *Water pollution control, *Hydrocarbons, *Biodegradation, *Water treatment, *Microorganisms, Groundwater, Nutrients, Oxygen, Nitrogen, Carbon dioxide, Water reuse.

Groundwater from hydrocarbon contaminated areas is treated with microorganisms, nutrients and gasses, such as oxygen, nitrogen, and carbon dioxide, to rapidly biodegrade the hydrocarbon material. The treated water containing microorganisms, nutrients and gases is returned to the contaminated area to be recirculated through the contaminated ground. The contaminated ground may also be treated by adding nutrients and oxygen, and/or other gases, to the returning treated water to increase the biodegradation process in situ. Thus, the water containing contaminated material is reused rather than removed and disposed of off-site and the contamination in the soil and the groundwater is reduced through continual biodegradation by the microorganisms which feed on the hydrocarbon compounds. (Cremmins-AEPCO)
W88-00602

EROSION CONTROL DEVICE,
For primary bibliographic entry see Field 4D.
W88-00606

AQUATIC WEED BARRIER,
Du Pont Canada, Inc., Mississauga (Ontario).
For primary bibliographic entry see Field 4A.
W88-00607

WATERPROOFING SOIL,
Clem Environmental Corp., Chicago, IL.
A. J. Clem.
U.S. Patent No. 4,501,788; February 26, 1985. 6 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1051, No 4, p 1644, February 26, 1985.

Descriptors: *Patents, *Waterproofing, *Water pollution control, *Water pollution prevention, *Soil sealants, *Impervious membranes, Soil contaminants, Ventilation, Hazardous materials, Radioactive wastes, Bentonite, Ponds, Lagoons, Industrial wastes, Barriers.

A moisture impervious sheet provides pollution control by acting as a water barrier for ponds and lagoons and as a soil sealant for hazardous or nuclear waste. The sheet contains a flexible non-biodegradable support to vent gas and it is coated with an adhesive and water swellable bentonite to retain its flexibility. A continuous uninterrupted barrier of bentonite faces the area from which water is to be barred. (Cremmins-AEPCO)
W88-00614

GROUNDWATER PROTECTION SYSTEM,
Environmental Design, Inc., Palm Beach, FL.
L. E. Wagner, H. F. Flannery, and R. W. Rakoczynski.
U.S. Patent No. 4,543,013; September 24, 1985. Official Gazette of the United States Patent Office, Vol 1058, No 4, p 1654-1655, September 24, 1985.

Descriptors: *Patents, *Water pollution prevention, *Waste disposal, *Industrial wastes, *Groundwater pollution, *Wastewater treatment, *Reservoirs, Leachates, Leaching, Leaking, Ponds, Lagoons, Landfills, Linings, Drainage, Drains.

A groundwater protection system comprises an impoundment for receiving and storing hazardous industrial wastes for subsequent treatment and disposal. The impoundment comprises a first compartment for receiving the wastes, a second compartment underlying the first one and containing reactive treatment material for treating any leakage from the first compartment, and a subsystem for substantially restricting migration of leakage between compartments. The system includes a liner constructed of material substantially impervious to the passage of the leakage. A drain connected to the second compartment removes leakage after it has been treated by the reactive treatment material. (Cremmins-AEPCO)
W88-00615

U.S. COAST GUARD EQUIPMENT DEPLOYMENT REQUIREMENTS FOR HAZARDOUS CHEMICAL SPILL RESPONSE,
Transportation Systems Center, Cambridge, MA.
J. Bellantoni, L. Frenkel, I. Litant, P. Fang, and J. Garlitz.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-123075. Price codes: A10 in paper copy, A01 in microfiche. CG-W-001-82, November 1982. Final Report. 216 p, 26 fig, 30 tab, 14 ref, 4 append.

Descriptors: *Chemical recovery, *Hazardous materials, *Water pollution control, Environmental protection, Water pollution prevention, Water pollution treatment, Coastal waters.

Studies were performed to determine the types, quantities and locations of equipment required by the U.S. Coast Guard to respond to spills of hazardous chemicals, over and above the resources of private industry, contractors and other government agencies. Strong response capabilities of specific types are available from EPA, DOD, local governments, industry groups and manufacturers. It was established that the national capability is about 59% commercial, 33 % private, and 8% governmental. Equipment for a 20-man response team was selected that can be fit into a single van. A seven-site configuration with a total of 11 such vans was recommended as offering the best combination of response time and van ability. (Halterman-PTT)
W88-00649

STRATEGY FOR THE PROTECTION OF UNDERGROUND WATER IN ILLINOIS.
Illinois State Environmental Protection Agency, Springfield. Water Plan Task Force.
Special Report No. 8, October 1984. 25 p, 2 append.

Descriptors: *Water quality standards, *Groundwater management, *Groundwater potential, *Aquifers, *Illinois, Water quality management, Groundwater depletion, Water policy, Groundwater availability, Water quality, Model studies, Geohydrology, Future planning, Water resources development, Water management.

In Illinois, the authority to protect groundwater resources is distributed among eight state agencies. However, in many cases, protection of underground water use is included in the statutes as a secondary objective. As a result, these statutes and regulations are at most only partially effective for the protection of groundwater. The Water Plan Task Force adopted a policy statement for the management of the state's groundwater resources. Short and long term recommendations were made for various policy issues. These issues address: establishment of levels of groundwater protection desired; determination of users and uses of groundwater; development of a resource inventory; treatment and treatability of groundwater; interaquifer exchange; determination of local, state and federal responsibilities for protection of groundwater; identification of degradation and depletion of groundwaters; and development and implementation of programs. Appendices include data on map modeling of groundwater quality for several types of aquifers, and use to yield analysis maps. (Geiger-PTT)
W88-00666

ESTUARY WATER QUALITY DATA STATISTICAL INTERFACE: SUPPORT ACTIVITIES REPORT.
Texas Natural Resources Information System, Austin.
TNRIS-019, June 1980. 23 p, 5 fig, 2 tab, 5 ref, append.

Descriptors: *Water quality, *Public health, *Shellfish, *Shellfish farming, *Computer programs, Salinity, Correlation analysis, Coliforms, Estuaries, Mathematical Studies, Estuarine fisheries, Computer models, Models studies, Water quality management, Bays, Statistical analysis, Mathematical models.

The Texas Natural Resources Information System (TNRIS) staff assisted the Texas Department of Health (TDH) Shellfish Sanitation Control Division to establish a mechanism for determining correlations between various constituents of shellfishing areas. To this end, TNRIS developed an automated interface between existing estuarine water quality data and a computer software package which provides for correlation analysis. TDH staff have used the computer interface to determine the correlation between salinity and coliform in bays on the Texas coast as a pilot effort to shorten the time needed to assess possible areas of contamination that should be closed to shellfishing. Although the system test identified very little correlation between coliform and salinity levels in bay systems as a whole, other analyses will be made using the computer capability established by this project. Cost of TNRIS support to the TDH staff totaled $2,642.53. In addition to the initial programming support, TNRIS maintains an active role in supporting the statistical study by the Shellfish Sanitation Control Division. The Estuarine Water Quality file and other TDH files are indexed in TNRIS for dissemination to users in the public and non-public sectors. (Geiger-PTT)
W88-00671

STATUS REPORT ON ABATEMENT OF WATER POLLUTION FROM THE CANADIAN PULP AND PAPER INDUSTRY (1982).
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
Report EPS 1/PF/1, October 1984. 19 p, 2 fig, 10 tab.

Descriptors: *Water pollution sources, *Pulp and paper industry, *Wastewater treatment, Water pollution prevention, Suspended solids, Effluent limitations, Regulations, Canada.

The 123 pulp and paper mills in Canada produced 63,687 tons per day in 1982. Total discharges were 1014 tons of total suspended solids per day and 3050 tons of BOD per day. Compared with 1980 figures, production had decreased by 1.8%; total suspended solids by 22%; BOD by 20%. Total suspended solids were reduced in all regions except the Northwest. If all mills were in compliance, discharges would be about 650 and 1820 tons per day of total suspended solids and BOD, respectively. In 1980 44% of mills complied with suspended solids discharge regulations; 66% with BOD regulations. In 1982 the compliance increased to 60% and 71%, respectively. About $1 billion was spent on abatement programs between 1969 and 1982, inclusive. A particular problem is the noncompliance of newsprint sulfite plants, most old and small and located in Quebec, Ontario, and the Atlantic regions. Present policy favors in-plant controls and process changes rather than treatment. (Cassar-PTT)
W88-00676

EFFECTS OF SODIUM HYDROXIDE SOLUTIONS ON THE PERMEABILITY OF MAGNESIUM CLAYS,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-00731

SURVEY OF POTENTIAL POPULATION EXPOSURES TO CHEMICAL CONTAMINANTS PRESENT IN UNPROTECTED SURFACE WATER SUPPLIES IN NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W88-00736

PRESENT AND POTENTIAL IMPACTS OF TOXIC SUBSTANCES ON MUNICIPAL GROUND WATER RESOURCES IN NORTH CAROLINA,
North Caolina State Univ., Raleigh. Div. of University Studies.
D. Huisingh, and J. R. Hatley.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205779/AS. Price codes: A07 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh. Completion Report No. 198, June 1983. 116 p, 9 fig, 3 tab, 68 ref, 3 app.

Descriptors: *North Carolina, *Groundwater contamination, *Sanitary landfills, *Waste dumps, *Water pollution sources, *Toxic waste sites, Toxic wastes, Toxic substances, Hazardous wastes, Water pollution, Surface water, Water, Hazardous waste sites, Chemical wastes.

The locations of approximately 2,000 toxic substances and hazardous waste problem sites in North Carolina are presented graphically in relation to the locations of the 260 towns and municipalities dependent upon groundwater. It is estimated that approximately 480,000 North Carolina residents utilize 64,000,000 gallons of groundwater daily through municipal wells. The groundwater of some of these municipalities is especially vulnerable to contamination from toxic substances that are or may emanate from the sites identified. Recommendations are made from increased monitoring for the presence of toxic substances in water from municipal and private wells in the vicinity of the toxic and hazardous waste sites identified. An integrated and comprehensive groundwater and surface water management strategy that will help ensure these resources for future generations is urgently needed. (Kiger-UNC-WRRI)
W88-00737

METHOD AND APPARATUS FOR REMOVING CONTAMINANTS FROM SOIL,
Foster Wheeler Energy Corp., Livingston, NJ.
For primary bibliographic entry see Field 5E.
W88-00766

OPERATING PROCEDURES AND QUALITY CONTROL ASSURANCE PROGRAM FOR WATER QUALITY MONITORING NETWORK.
Ohio River Valley Water Sanitation Commission, Cincinnati.
For primary bibliographic entry see Field 5A.
W88-00797

GROUND-WATER PROTECTION STRATEGY.
Environmental Protection Agency, Washington, DC. Office of Ground-Water Protection.
August 1984. 75 p, 1 tab, 18 ref, 6 append.

Descriptors: *Groundwater pollution, *Water quality management, *Water pollution prevention, *Environmental protection, *Water quality control, Water pollution sources, Drinking water, Groundwater, Decision making, Water pollution control, Groundwater potential, Interagency cooperation, Management planning.

Officials at all levels of government have been searching for a strategy to protect groundwater. The U.S. EPA formed a Groundwater Task Force to identify areas of inconsistencies among programs, assess the need for program coordination within the EPA, and help strengthen the States' capabilities to protect groundwater resources. New technologies are being adopted to prevent, control, and clean up groundwater contamination. The EPA groundwater protection strategy encompasses short-term build-up of institutions at the State level, assessing unaddressed sources of contamination, issuing guidelines for EPA decisions affecting groundwater protection and cleanup, and strengthening EPA's organization for groundwater management at several levels. EPA will provide support to States for program development and institution building and address contamination from underground storage tanks. EPA will study the need for further regulation of land disposal facilities, including surface impoundments and landfills. EPA will adopt guidelines for consistency in its groundwater protection programs. EPA will accord different levels of protection to each of three classes of groundwater. Class I includes groundwater highly vulnerable to contamination. Class II includes potential drinking water sources. Class III is groundwaters of limited beneficial use. Finally, EPA will improve its own institutional capability to protect groundwater. (Geiger-PTT)
W88-00800

REVIEW OF TRENDS IN LAKE ERIE WATER QUALITY WITH EMPHASIS ON THE 1978-1979 INTENSIVE SURVEY,
Ohio State Univ., Columbus. Center for Lake Erie Area Research.
D. E. Rathke, and C. J. Edwards.
June 1985. 129 p, 48 fig, 16 tab, 96 ref.

Descriptors: *Nutrients, *Lake Erie, *Water quality, *Surveys, *Eutrophication, Monitoring, Phosphorus, Biological properties, Nitrates, Nitrites, Chlorophyll, Nutrient cycling, Metals, Chemical properties, Physical properties.

This report is designed to aid in assessing the success of efforts to reduce cultural eutrophication and contamination from toxic substances in Lake Erie and to demonstrate the importance of physical, chemical, and biological relationships in interpreting empirical observations. Physical data suggest that meteorological events have a major effect on many chemical and biological processes. Major impacts have been documented from sediment resuspension and settling; oxygenation and anoxia of the central basin hypolimnion; interbasin water exchange; and temporary stratification of the western basin. Chemical data show oxygen depletion and eutrophication in the central basin hypolimnion. Phosphorus loadings have declined over the past several years while nitrate and nitrite loadings have increased. Recent studies have indicated the existence of elevated levels of As, Cd, Cu, Fe and Se in the water column, and Cd, Cr, Cu, Pb, Hg, Ni and Zn in the sediments. Phytoplankton species and biomass studies show that the central and eastern basins have a similar seasonal cycle with peak biomass occurring in the spring and fall. Chlorophyll a levels have decreased since 1970 in the three basins. Recommendations for future data collections for the monitoring of water quality of Lake Erie are made. (Geiger-PTT)
W88-00801

IMPROVED BIOLOGICAL TREATMENT WITH A SECONDARY FLOTATION CLARIFIER,
Krofta Engineering Corp., Lenox, MA.
For primary bibliographic entry see Field 5D.
W88-00805

EVALUATION OF URBAN NONPOINT SOURCE POLLUTION MANAGEMENT IN MILWAUKEE COUNTY, WISCONSIN: EXECUTIVE SUMMARY,
Wisconsin Dept. of Natural Resources, Madison.
R. Bannerman, K. Baun, and M. Bohn.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-114156. Price codes: A02 in paper copy, A01 in microfiche. 1983. 8 p. Contract No P005432-01-5.

Descriptors: *Nonpoint pollution sources, *Pollution load, Water pollution control, Water pollution prevention, Management planning, Planning, Milwaukee County, Wisconsin, Storm water, Storm runoff, Storm sewers, Storm drains.

The executive summary of a three-volume report pertaining to urban stormwater runoff is presented. The characteristics of urban stormwater are summarized, the impacts of urban stormwater are described, sources of urban stormwater contaminants are listed, management alternatives for urban stormwater are outlined, and the feasibility and application of urban nonpoint source water pollution treatment measures are discussed. (See W88-00808, W88-00810, and W88-00811) (Halterman-PTT)
W88-00809

EVALUATION OF URBAN NONPOINT SOURCE POLLUTION MANAGEMENT IN MILWAUKEE COUNTY, WISCONSIN; VOLUME II: FEASIBILITY AND APPLICATION OF URBAN NONPOINT SOURCE WATER POLLUTION ABATEMENT MEASURES.
Wisconsin Dept. of Natural Resources, Madison.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-114172. Price codes: A07 in paper copy, A01 in microfiche. 1983. 119 p, 6 fig, 30 tab, 6 maps, 28 ref, 6 append. Contract No. P005432-01-5.

Descriptors: *Nonpoint pollution sources, *Urban runoff, *Pollution load, *Water pollution control, *Water pollution prevention, *Wisconsin, Management planning, Planning, Milwaukee County, Storm water, Storm runoff, Storm sewers, Storm drains.

The findings, conclusions and recommendations of a study of the characteristics, sources and management of urban stormwater pollution in Milwaukee, Wisconsin are presented in a three-volume report. The impacts of urban stormwater are also described, and the feasibility and application of urban nonpoint source water pollution treatment measures are discussed. Volume 2 evaluates the feasibility, costs and pollutant removal effectiveness of street sweeping, stormwater detention and retention basins, and catch basin cleaning. The application of these measures is demonstrated for three watersheds in southeastern Wisconsin, The level of pollutant loading reduction achieved by street sweeping is relatively modest. Sweeping is most effective in spring and fall, and in high density urban developments. Relatively high levels of pollutant removal can be achieved by retention basins or modified detention basins. The use of these basins was generally found to be more cost effective than increased street sweeping. (See W88-00808, W88-00809, and W88-00811) (Halterman-PTT)
W88-00810

REAERATION THROUGH GATED-CONDUIT OUTLET WORKS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8C.
W88-00814

CITIZENS'S HANDBOOK ON GROUNDWATER PROTECTION,
Natural Resources Defense Council, Inc., New York.
W. Gordon.
1984. 208 p.

Descriptors: *Groundwater, *Groundwater pollution, *Groundwater management, *Water pollution prevention, *Water pollution control, Environmental protection, Public health, Handbooks Regulations, Water law, Water quality control.

This handbook aims to provide citizens, community groups and government officials with basic information about groundwater, its contamination, and the regulations and methods being used or being considered to protect it. The handbook identifies and describes those sections of the environmental protection laws that invite the active participation of the public. It includes ways in which the public can initiate the development of groundwater protection strategies and laws. Part one of the handbook reviews aspects of groundwater - uses, quality, contamination, health risks of contaminants, and groundwater protection. Part two emphasizes the role of citizens in groundwater protection. Part three deals with getting groundwater tested for possible contamination and temporary home water treatment. Part four outlines the laws, regulations and institutions that handle groundwater protection. Part five contains a summary of questions to be asked to determine methods of community groundwater protection. Appendices to the handbook are: a chart of the U.S. Environmental Protection Agency, state groundwater contacts, state groundwater statutes, State

agency administrative responsibility, regional quality assurance coordinators, and RCRA permit application. (Geiger-PTT)
W88-00816

REVEGETATION FOR WILDLIFE ENHANCEMENT ALONG THE LOWER COLORADO RIVER,
Arizona State Univ., Tempe. Center for Environmental Studies.
For primary bibliographic entry see Field 6G.
W88-00820

GREAT LAKES WATER QUALITY BOARD, REPORT TO THE INTERNATIONAL JOINT COMMISSION, 1985 REPORT ON GREAT LAKES WATER QUALITY.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Regional Office.
For primary bibliographic entry see Field 5B.
W88-00821

RADIOTELEMETRY TRACKING AT LAKE CONWAY, FLORIDA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W88-00837

REAERATION TESTS, ENID LAKE OUTLET WORKS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
C. H. Tate.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-113593. Price codes: A03 in paper copy, A01 in microfiche. Technical Report E-82-2, February 1982. Final Report. 32 p, 6 fig, 8 ref, 2 append.

Descriptors: *Water quality control, *Reservoirs, *Aeration, *Outlets, *Tracers, *Mississippi, Radioactive tracers, Lake Enid, Conduits, Mass transfer, Dissolved oxygen, Stilling basins.

Radioactive tracers (krypton-85 and tritium) were used to determine the gas transfer characteristics of the outlet structure at Lake Enid, Mississippi. This sampling technique allowed separate measurement in the outlet conduit, the trajectory between the conduit and the tailwater, and the submerged portion of the stilling basin. Dissolved oxygen was also measured in the conduit. The radioactive tracer technique did not reflect the dissolved oxygen depletion as a result of oxygen sinks such as hydrogen sulfide, iron, and manganese. The Lake Enid outlet structure produced high dissolved oxygen concentrations, satisfying over 80% of the initial dissolved oxygen deficit. Dissolved oxygen probes used in the study did not perform satisfactorily because water forced into the electrical connection between the probe and cable caused readings to go off the scale. The radioactive tracer technique may not be feasible for flows greater than 1000 cfs. Results from this study can be used to predict gas transfer characteristics with similar structures and flow regimes. (Cassar-PTT)
W88-00844

REAERATION AT NAVIGATION LOCKS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W88-00846

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 8: SUMMARY REPORT,
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 8B.
W88-00856

NORFOLK LAKE, ARKANSAS, TEMPERATURE ANALYSIS: MATHEMATICAL MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. P. Holland, M. S. Dortch, and D. R. Smith.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-117670. Price codes: A05 in paper copy, A01 in microfiche. Technical Report HL-82-12, April 1982. Final Report. 76 p, 3 fig, 8 tab, 17 plates, 12 ref, append.

Descriptors: *Water quality control, *Reservoir operation, *Temperature, *Pumped storage, *Norfolk Lake, *Arkansas, Water temperature, Mathematical models, Model studies, Hydroelectric power, Numerical analysis, Lakes.

The impact of a proposed hydropower modification upon the thermal structure proposed reregulation structure was investigated with a one-dimensional of the Norfolk Lake and upon the releases from the numerical model. The numerical simulation model was adapted from previous analyses of pumped-storage projects (Marysville and Dickey-Lincoln School Lakes hydrothermal studies). The approach involved the selection of three study years (1974, 1975, and 1976) and simulation of lake operation for each year with and without pumped storage hydropower. The simulations without pumped storage operations were compared with the existing data bases for the respective years to verify the accuracy of the simulations. Subsequently, the simulations with pumped storage operations were compared with the simulations with conventional hydropower operations to determine the relative thermal changes both in the reservoir and the release that would have occurred with pumped storage operations in the respective or similar years. (Author's abstract)
W88-00858

OPTIMAL CONTROL OF RESERVOIR DISCHARGE QUALITY THROUGH SELECTIVE WITHDRAWAL: HYDRAULIC LABORATORY INVESTIGATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. G. Fontane, J. W. Labadie, and B. Loftis.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-112007. Price codes: A03 in paper copy, A01 in microfiche. Technical Report E-82-1, February 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 33 p, 10 fig, 12 ref.

Descriptors: *Water quality control, *Reservoirs, *Temperature, Optimization, Dynamic programming, Model studies, Reservoir operation, Water temperature, Stratification, Thermal stratification.

This report presents a method for combining simulation and optimization techniques to determine guidelines for operating selective withdrawal reservoir structures to meet downstream water temperature objectives. Optimal operation is achieved when operating rules that anticipate future critical temperature conditions are successfully applied. In this study, a one-dimensional reservoir thermal simulation model developed by the U.S. Army Engineer Waterways Experiment Station was used to simulate the thermal stratification cycle of a reservoir. The model was interfaced with a formulation called objective-space dynamic programming (OSDP) to develop the optimal operation strategy for each decision period. The OSDP formulation retains the integrity of the simulation model and minimizes an objective function related to deviations of predicted release temperature from downstream target temperature over a period of the stratification cycle. Application to a case study shows the potential for using the dynamic programming technique, as compared to the normal period-by-period operation, to improve performance of the system. (Author's abstract)
W88-00866

STUDY PROGRAM FOR DEVELOPMENT OF INFORMATION FOR USE OF OECD EUTROPHICATION MODELING IN WATER QUALITY MANAGEMENT: A QUALITY CONTROL IN RESERVOIRS COMMITTEE REPORT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W88-00869

GEOLOGY FOR ENVIRONMENTAL PLANNING IN STARKE COUNTY, INDIANA,
Indiana State Dept. of Natural Resources, Indianapolis.
E. J. Hartke.
Geological Survey Occasional Paper 42: Environmental Study 19, 1984. 13 p, 8 fig, 7 ref.

Descriptors: *Groundwater pollution, *Management planning, *Aquifers, *Groundwater management, *Water pollution prevention, Geohydrology, Groundwater hydrology, Flood plains, Flood plain management, Geology, Environmental protection, Unconfined aquifers, Confined aquifers, Sand aquifers.

This report is intended to provide geologic data to planners, government officials, consultants, and others who plan for the environmentally sound use of the resources in Starke County. Starke County lies within the Kankakee Outwash and Lacustrine Plain. The surface geology consists mostly of sands, silts, clays, gravels and mixtures thereof that compose the lacustrine plains, outwash plains, and valley trains dominating the landscape. No major mineral deposits exist in Starke County. Groundwater of acceptable quality generally is readily available from three hydrostratigraphic units in Starke County - the shallow unconfined sand and gravel aquifer, the deep confined sand and gravel aquifer, and the bedrock aquifer. Potential groundwater contamination is greatest in the shallow unconfined aquifer. The three aquifer systems appear to be poorly connected. Several land use restrictions should be considered in the county. The flood plains of the Kankakee River should remain free of manmade structures, protective vegetation should not be removed from the dunes, and the shallow groundwater system should be protected from potential surface-deployed contaminants. Most of the county is poorly suited for sanitary landfills. The coarse-grained surface materials in Starke County are not suitable for the use of septic systems. If the deep confined aquifer is used as a water supply, the well casing should be upgradient of the water table and sealed both at the surface and in the clay layer. (Geiger-PTT)
W88-00871

NONLINEAR PROGRAMMING METHODS IN RESERVOIR SYSTEM MANAGEMENT,
Tennessee Univ., Knoxville.
R. E. Rosenthal, M. Hanscom, and R. S. Dembo.
Research Report No. 93, April 1983. U.T. Publication Number R01-2550-007-83. Final Technical Completion Report. 49 p, 32 ref. Contrast No. 14-34-0001-1265. Project No. B-054-Tenn.

Descriptors: *Management planning, *Decision making, *Mathematical models, *Reservoir operation, *Nonlinear programming, Model studies, Models, Computer models, Water quality, Reservoirs, Water resources management, Mathematical studies, Computer programs.

Models can be applied to reservoir management to facilitate the decision making process. Models can provide or confirm insight into the nature of problems and can be used in studies of alternative system configurations. The complex model can be used for long-term planning, exploring network topology, estimating hydropower output (short-term), calculating nonseparable benefits, predicting uncertainty, and considering biological factors that affect reservoir water quality and temperature. Several methods of nonlinear programming are examined and applied to reservoir management models. They include: a specialization of the Kuhn-Tucker theory, algorithmic structure, reduced gradient methods, successive linear programming (approximation programming), and successive quadratic programming. The truncated-Newton algorithms, a new class of methods for applying nonlinear programming to reservoir

system optimization, are also examined. (Geiger-PTT)
W88-00884

EFFECTS OF RESERVOIR RELEASES ON WATER QUALITY, MACRO-INVERTEBRATES, AND FISH IN TAILWATERS: FIELD STUDY RESULTS,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
For primary bibliographic entry see Field 6G.
W88-00888

FARMER PARTICIPATION IN THE HALL COUNTY ACP SPECIAL WATER QUALITY PROJECT, NEBRASKA, 1980,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
H. Hoover, and R. Oscar.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-151381. Price codes: A03 in paper copy, A01 in microfiche. ERS STaff Report No. AGES820319, March 1982. 24 p, 1 fig, 16 tab, 2 append.

Descriptors: *Surveys, *Nitrogen, *Water quality control, *Water quality management, *Attitudes, Nitrates, Leaching, Water quality, Public opinion, Public participation, Groundwater management, Groundwater pollution, Fertilizers, Farm management, Agricultural runoff.

One hundred and three farm operators in the Hall County Agricultural Conservation Program (ACP) Special Water Quality Project area in Nebraska were interviewed to determine perceptions of water quality problems and awareness of the ACP Special Water Quality Project. The ACP project is one of 21 projects selected nationwide to accelerate conservation practices and develop techniques to improve water quality. The project area in Hall County has an excess of nitrate-nitrogen (NO3-N) in the groundwater. The purpose of the special water quality project was to assist farm operators in carrying out recommended practices and techniques to reduce NO3-N levels in groundwater caused by nitrate leaching. Results of the survey showed that two-thirds of the farm operators indicated that high nitrate concentrations in the ground water were a problem. While three operators in four indicated a need to reduce the leaching of nitrates, only half of the sample agreed that irrigation contributed to the problem. Over 70% of the operators used nitrate management practices and 81% followed recommended nitrogen fertilizer application rates. There was a high level of awareness (91%) of the ACP Special Water Quality Project, and about 75% of the operators reported receiving the project newsletter. (Geiger-PTT)
W88-00892

RELATING STREAM STANDARDS TO WATER QUALITY MONITORING PRACTICES,
Colorado State Univ., Fort Collins.
R. C. Ward, G. M. Smillie, J. C. Loftis, and T. G. Sanders.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-166710. Price codes: A09 in paper copy, A01 in microfiche. NSF/PRA-82001, January 1982. Final Report. 180 p, 11 fig, 16 tab, 98 ref, append. Contract No. PRA-7913073.

Descriptors: *Water quality control, *Standards, *Monitoring, *Model studies, Little Wabash River, Illinois, Mathematical models, Water pollution, Water policy.

Six methods for enhancing the relationship between management and water quality monitoring were evaluated using data from the Little Wabash River, Illinois: (1) Probability modeling expresses stream standard violations in terms of the probability of a violation. (2) Multiple linear regression uses a daily record of a few indicator quality variables to augment a sparser record (usually monthly) of other quality variables. (3) Conditional probability modeling estimates the probability of a stream standard violation under given conditions of streamflow, temperature, dissolved solids content, or other indicator variables. (4) The water quality change index combines the use of statistical hypothesis testing with conditional probability modeling to make quantitative statements regarding the likelihood that a particular variable has either improved or degraded with time. (5) The stream standards compliance index combines information regarding several variables into a single number (0 to 100, with 0 indicating at least one variable violates a stream standard.) (6) Confidence limits are placed on individual points on the cumulative distribution function of a water quality variable which has been estimated from grab sample data. Current standards and monitoring practices are reviewed. It is suggested that more attention be given to developing a sound scientific understanding of water quality stochastic processes. Ways of differentiating between natural and man-made violations must be provided. The implications of these water quality evaluations on public policy are reviewed. (Cassar-PTT)
W88-00893

ECONOMIC BENEFITS OF CONTROLLING WATER POLLUTION IN AN IRRIGATED RIVER BASIN: METHODOLOGY AND APPLICATION,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W88-00908

SAN FRANCISCO BAY AREA NATIONAL URBAN RUNOFF PROJECT. DEMONSTRATION OF NON-POINT SOURCE POLLUTION MANAGEMENT ON CASTRO VALLEY CREEK: EXECUTIVE SUMMARY.
Alameda County Flood Control and Water Conservation District, Hayward, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-163097. Price codes: A03 in paper copy, A01 in microfiche. June 1981. 29 p, 10 fig, 3 tab.

Descriptors: *Runoff, *Storm runoff, *Urban runoff, *Water quality control, Water pollution control, Pollutants, Nonpoint pollution sources, Management planning, Water quality.

The results of a nonpoint source pollution management project, on a creek receiving street cleaning and urban runoff, are presented and conclusions of the study are discussed. As a result of two years of efforts, this project demonstrated that street cleaning can effect a substantial reduction in the amount of lead and total solids, as measured in the runoff water. A maximum of 35% of lead and 20% of total solids can be prevented from entering the runoff by very frequent street cleaning (more than three passes per week). Information on the effectiveness of less frequent sweeping was also developed. The results of this project, in conjunction with other Nationwide Urban Runoff Program street cleaning projects, will help identify the role of street cleaning in meeting the goals of the 1972 Federal Water Pollution Control Act Amendments. (Halterman-PTT)
W88-00914

SAN FRANCISCO BAY AREA NATIONAL URBAN RUNOFF PROJECT: A DEMONSTRATION OF NON-POINT SOURCE POLLUTION MANAGEMENT ON CASTRO VALLEY CREEK; APPENDIX.
Alameda County Flood Control and Water Conservation District, Hayward, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-163113. Price codes: A08 in paper copy, A01 in microfiche. June 1981. 170 p, 48 fig, 54 tab.

Descriptors: *Runoff, *Stormwater runoff, *Urban runoff, Water pollution control, Pollutants, Nonpoint pollution sources, Management planning, Water quality, Water quality control.

Field and laboratory data, reduced by computation to tables and figures, from a nonpoint source pollution management project on Castro Valley Creek are presented. The study was performed to demonstrate the relationship between street cleaning and runoff. Data were analyzed to correlate street surface pollutant loadings before rain events, with changes in runoff water pollution mass yields. An expanded description of the study area, the project design, and the procedures are also presented in this appendix volume. (Halterman-PTT)
W88-00915

TOXICS MANAGEMENT IN CALIFORNIA.
California Hazardous Substance Task Force, Sacramento, CA.
For primary bibliographic entry see Field 6E.
W88-00919

CLEANING UP THE DELAWARE RIVER, A STATUS AND PROGRESS REPORT PREPARED UNDER THE AUSPICES OF SECTION 305(B) OF THE FEDERAL CLEAN WATER ACT,
Delaware River Basin Commission, Trenton, NJ.
R. C. Albert.
March 1982, 22 p, 10 fig, 3 tab, 11 ref, 2 append.

Descriptors: *Delaware River, *Water pollution, *Stream pollution, *Regional planning, *Primary wastewater treatment, *Secondary wastewater treatment, *Recreation demand, River basins, Wastewater facilities, Wastewater treatment, Advanced wastewater treatment, Water pollution sources, Water pollution treatment.

The Delaware River, which is formed by the confluence of its east and west branches near Hancock, New York, on the Pennsylvania-New York state border, historically has been noted for its water pollution. The first generation water pollution control efforts, largely completed by 1960, resulted in secondary treatment levels at most treatment plants above Philadelphia. Primary treatment was considered adequate in the estuary below Philadelphia. When the water quality of the Delaware River including the tidal estuary and bay was assessed, 81% of the river length was found to be currently meeting the 1983 federal 'swimmable' water quality goal. This figure is anticipated to increase to 85% by 1983. Eight-nine percent of the Delaware River length currently meets the federal 1983 'fishable' water quality goal. The 15% of the river that is not anticipated to meet both the 'swimmable' and 'fishable' water quality goals by 1983 is the middle Delaware River estuary. The most recent trends in water quality improvement are higher dissolved oxygen concentrations and lower fecal coliform levels in the reach of the estuary below Philadelphia. This latter improvement is related to upgrading of the Philadelphia Southwest water pollution control plant. Some of the many water quality problems that remain are toxic pollution, non-point pollution and deficits in wastewater treatment. (Hawkins-Omniplan)
W88-00920

1983 ANNUAL REPORT - REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE.
International Joint Commission-United States and Canada, Windsor (Ontario). Aquatic Ecosystem Objectives Commission.
For primary bibliographic entry see Field 5B.
W88-00928

OPERATIONAL, SPATIAL AND ENVIRONMENTAL WATER PLANNING AND ANALYSIS,
Michigan State Univ., East Lansing. Center for Remote Sensing.
J. F. Bartholic, K. M. Kittleson, and B. Bill.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 217204/AS. Price codes: A03 in paper copy, A01 in microfiche. Michigan Institute of Water Research, E. Lansing, Technical Report No. G1232-05, March 1987. 22 p, 6 ref, 5 append. Grant No. 14-08-0001-G1232.

Descriptors: *Model studies, *Computer models, DRASTIC, AGNPS, PRZM, USLE, Nutrients, Watersheds, Groundwater, Surface water, Nonpoint pollution sources, Branch County, Michigan.

Several models simulating the movement of nutrients, chemicals, and particulates, through surface and groundwater were reviewed. One model, the Agricultural Nonpoint Source Pollution Model (AGNPS), was modified to run on an AT&T 3B2 and an IBM-AT computer. User-friendly prompts were incorporated and the model was applied in Branch County, Michigan. (MI St. U., IWR)
W88-00943

6. WATER RESOURCES PLANNING

METHOD OF STORING LOGS,
British Columbia Research Council, Vancouver.
G. J. Esplin.
U.S. Patent No. 4,586,848; May 6,1986. 3 p, 2 fig.
Official Gazette of the United States Patent Office, Vol 1066, No 1, p 246, May 6, 1986.

Descriptors: *Patents, *Logging, *Storage, *Estuaries, Forest management, Containment, Haloclines.

Log rafts or bundles are stored in an artificial estuary to prevent environmental damage from marine life and the uptake of sea salt. A containment curtain is deployed around the logs admitting fresh water into the region defined by the curtain to form a two layered bay. The upper bay contains fresh water and the logs to be stored; the lower layer of water comprises salt water. (Cremmins-AEPCO)
W88-00507

6A. Techniques Of Planning

RISK ANALYSIS AND TIME-DEPENDENT FLOOD MODELS,
Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Wasserwirtchaft.
For primary bibliographic entry see Field 2E.
W88-00007

SCREENING TACTICS IN A WATER MANAGEMENT POLICY ANALYSIS FOR THE NETHERLANDS,
RAND Corp., Santa Monica, CA.
For primary bibliographic entry see Field 6B.
W88-00026

OPTIMIZING THE CONJUNCTIVE USE OF SURFACE AND GROUNDWATER,
For primary bibliographic entry see Field 4B.
W88-00397

FLOODS ON VALLEY RIVER, TATHAM CREEK, AND JANALUSKA CREEK IN THE VICINITY OF ANDREWS, NORTH CAROLINA.
For primary bibliographic entry see Field 2E.
W88-00645

PREDICTION METHODS,
Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2J.
W88-00699

NONLINEAR PROGRAMMING METHODS IN RESERVOIR SYSTEM MANAGEMENT,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5G.
W88-00884

OPERATIONAL, SPATIAL AND ENVIRONMENTAL WATER PLANNING AND ANALYSIS,
Michigan State Univ., East Lansing. Center for Remote Sensing.
For primary bibliographic entry see Field 5G.
W88-00943

6B. Evaluation Process

SCREENING TACTICS IN A WATER MANAGEMENT POLICY ANALYSIS FOR THE NETHERLANDS,
RAND Corp., Santa Monica, CA.
W. E. Walker, and M. A. Veen.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1145-1151, July 1987. 3 fig, 3 tab, 6 ref.

Descriptors: *Policy analysis, *Cost-benefit analysis, *Water management, *Netherlands, Evaluation, Flow discharge, Water storage, Lakes, Waterways, Costs, Water demand.

Large policy studies generally involve too many alternative policies to examine each in detail. As a result, such studies often include a step in which policy options (tactics) that are clearly unattractive are screened out. The output from this step is a small list of tactics that deserve a more thorough evaluation. Th screening of tactics to change the movement and storage of water in lakes and waterways of the Netherlands is described. This analysis was part of a larger study to help the Dutch government develop a new water management policy. The screening process for each tactic involved obtaining an upper bound (UB) on the expected annual benefits from the tactic under various assumptions about future water demands and comparing this upper bound with the tactic's annualized fixed cost (AFC). If the AFC was less than the UB, the tactic was considered promising and was retained for further analysis. If not, the tactic was screened out. Results from the screening analysis allowed informed policy decisions that will avoid investment expenditures of hundreds of millions of dollars and will reduce agricultural damage by about 15 million dollars/year. (Author's abstract)
W88-00026

LOCAL AND REGIONAL ECONOMIC IMPACTS,
R. A. Young.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 244-272, 1 fig, 2 tab, 22 ref.

Descriptors: *Planning, *Evaluation, *Water policy, *Agriculture, *Irrigation, *Economic aspects, Water policy, Water transfer, Water rights, Water allocation.

The direct and indirect economic impacts of potential transfers of water from agriculture to alternative uses are explored. The potential reductions in net farm income and regional farm-related income and employment are compared with the gains in those sectors which receive reallocated water supplies. Direct economic impacts to the agricultural sector are registered on the products in which value productivity is lowest (forage, food and feed grain production). Here the net economic value foregone for a 10-20% supply reduction id $5-$30 per acre-foot. The gains in net value of product or in willingness to pay in households and industries are 5 to 10 times higher. Indirect impacts are measured by income from primary regional resources and by employment per unit of water, including multiplier effects. Indirect losses associated with transferring from agriculture is dwarfed by the gains in nonagricultural sectors. The sector most likely affected (forage, food and feed grains) yields relatively small indirect employment and income effects compared with the emerging urban sectors. The economic interests of farmers whose water is transferred to urban uses are generally protected by state water and property rights laws. The rate of loss of irrigation water will probably be relatively slow so that the affected workers and businessmen have time to adjust. Little need is seen for specific public policies to deal with these changes. (See also W88-00291) (Cassar-PTT)
W88-00302

SOCIAL IMPACTS UPON URBAN COMMUNITIES,
L. J. Gibson.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 331-353, 4 fig, 7 tab.

Descriptors: *Planning, *Social impact, *Water policy, *Agriculture, *Irrigation, Social aspects, Water scarcity, Economic impacts.

Initially, a simple general model is introduced to describe what might happen should irrigated agriculture be eliminated or greatly reduced in the semiarid West. Consideration of this general model raises a number of additional questions: (1) what are the spatial patterns of potential impacts; (2) what are the employment implications; and (3) what are the potential scale and other mitigative effects. The first question is addressed by analysis of several maps which show the location and relative importance of irrigation agriculture. Data clearly show that irrigation activity is highly concentrated in a handful of states. The second question is approached through case studies which focus on agricultural employment in three states which have exceptionally high levels of irrigation agriculture. 'Worst case' estimates of employment dislocation are offered. Finally, speculation is offered as to the scale effects and other mitigative effects that will likely soften dislocation impacts. Given the history of outmigration from agricultural areas, additional declines in agricultural population are likely to be of modest magnitude and of unmanageable proportions when viewed from both the perspective of rural sending areas and of urban receiving areas. (Lantz-PTT)
W88-00306

AQUATIC ECOLOGICAL ASSESSMENTS: REGIONAL DATA SOURCES AND THEIR APPLICATION,
Argonne National Lab., IL. Energy and Environmental Systems Div.
J. E. Vancil, S. W. Ballou, and J. B. Levenson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-002291. Price codes: A06 in paper copy, A01 in microfiche. ANL/EES-TM-195, October 1982. 110 p, 1 fig, 18 tab, 96 ref, 2 append. Contract No. W-31-109-Eng-38.

Descriptors: *Aquatic environment, *Ecology, *Data collections, Fisheries, Resources development, Resources management, Water management, Oil shale, Water fowl.

The availability of aquatic ecology data and its recommended use for impact assessments are discussed. This information is critical for evaluating ecological effects of energy-related activities, especially when projecting effects for broad geographical areas. Regional data are identified, and examples of how these data sources can be used in assessing energy activities are provided. (Halterman-PTT)
W88-00483

SOCIAL FEASIBILITY AS AN ALTERNATIVE APPROACH TO WATER RESOURCE PLANNING,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
M. S. Hrezo, and W. J. Howe.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201075/AS. Price codes: A04 in paper copy, A01 in microfiche. Bulletin 149 (VPI-VWRRC-BULL 149), October 1985. 53 p, 7 tab, 107 ref. Project No. 374904.

Descriptors: *Public participation, *Water resource planning, Management, *Virginia, *Information transfer, Education, Research, Grants.

This research examined the approaches of 31 states to including public participation in water resource planning and reviewed the available literature on the subject in order to evaluate (1) the nature and extent of public participation in this area and (2)

the compatibility between citizen involvement techniques and policy types. It found a wide gap between the advice on public participation offered by the literature and current state participation programs. The literature suggests consulting a wide number and variety of citizens and interests, involving participants throughout the planning process, utilizing several different types of techniques - especially those requiring dialogue between planners and the public - and allowing citizens to help evaluate and select plans. The current pattern of public participation in water resources planning, on the other hand, consists of participation by limited numbers, in limited ways, at limited points in the process. The research suggests that conflict over public participation in water resource planning is due, in part, to confusion over the nature of the policies involved. Based on these findings, two models to bridge the gap by incorporating greater consideration of policy type into water resource planning are offered: (1) Social Feasibility Model and (2) the Political Feasibility Model. The report suggests that although the Political Feasibility Model has been widely accepted in water resource planning, planners have not understood that social and redistributive policies involving value conflicts are best chosen though the Social Feasibility Model. The report also offers guidelines for implementing the Social Feasibility Model. (USGS)
W88-00543

PROCEEDINGS, MISSISSIPPI WATER RESOURCES CONFERENCE, 1985.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201083/AS. Price codes: A07 in paper copy, A01 in microfiche. 1985. 140 p. Contract No. G915.

Descriptors: *Conferences, *Mississippi, *Water management, Data storage and retrieval, Interbasin transfer, Water law, Water rights, Legal aspects, Computer models, Mathematical models, Hydraulic models, Model studies, Groundwater, Groundwater movement, Surface water, Economic impact, Waterways.

The proceedings of the fifteenth Mississippi water resources conference are compiled. In this conference, papers focused on specific problems, systems, and methods applicable to water management in the state and the region. Nineteen papers by separate authors addressed information/data management, assessed economic impacts of water use and management, presented modeling techniques for various surface and groundwater problems, presented water quality studies, reviewed alternative sources of supply, and discussed legal issues related to water transfer and, in particular, to proposed water law changes in Mississippi. (Hawkins-MS St U.)
W88-00544

LONG-RUN FORECASTING OF REGIONAL ECONOMIC ACTIVITY FOR USE IN WATER RESOURCE PROJECT EVALUATIONS,
Ohio State Univ., Columbus. Museum of Zoology.
S. P. Coelen.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201059/AS. Price codes: A04 in paper copy, A01 in microfiche. Pennsylvania Institute on Land and Water Resources, University Park, Technical Completion Report to Bureau of Reclamation, July 1983. 58 p, 2 fig, 2 tab, 12 ref. Project No. OWRT B-114-PA(1).

Descriptors: *Long-term planning, *Population dynamics, *Future planning, *Water demand, *Econometrics, *Water resources development, Project planning, Evaluations, Human population, Economic aspects, Projections, Forecasting, Planning, Regional development.

Population trends and regional economic activity were evaluated for use in the planning of water resource programs. Population growth significantly and directly affects water resource needs. In studying population forecasting for water resource utilization, an evaluation of the accuracy of the county population estimates forecast by the Bureau of Census was made. The accuracy of the Bureau of Economic Analysis population and earnings forecasts and other econometric models were evaluated. In addition, this research evaluated the quality of work on population forecasts done with regard to a project designed to high-flow-akim the Connecticut River. The excess water obtained from this process will be placed in the Quabbin Reservoir for use by the Metropolitan District Commission in serving the Boston metropolitan area through 2030. Federal and state water subsidies to provide clean water in the future are examined in an appendix. (Geiger-PTT)
W88-00549

ECONOMIC EVALUATION OF THE COLORADO RIVER BASIN SALINITY CONTROL PROGRAM,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
R. L. Gardner, and R. A. Young.
Western Journal of Agricultural Economics, Vol. 10, No. 1, p 1-12, July 1985. 4 tab, 20 ref.

Descriptors: *Economic aspects, *Evaluation, *Salinity control, Salinity, Colorado River, Water Quality Control, Dissolved salts, Benefits, Estimated costs, Cost comparisons, Water use.

Dissolved salts (salinity) adversely affect numerous urban and agricultural users of Colorado River water in California and Arizona. Congress in 1974 authorized a major salinity control program. Studies of general economic benefits from salinity abatement and the cost per unit of salinity reduction expected from specific proposed projects have been developed by the responsible federal agencies, but no project-by-project evaluation has been published. A conceptional basis was found for a substantial downward revision of prospective economic benefits of salinity abatement. Revised benefits are compared with estimated costs, and only for five of the nineteen projects do economic benefits appear to exceed costs. (Author's abstract)
W88-00561

PROTOTYPE EVALUATION OF SELECTED NEPA PREDICTED ENVIRONMENTAL IMPACTS FOR CONSTRUCTION GRANTS PROJECTS.
ESEI/EcolSciences, South Bend, IN.
For primary bibliographic entry see Field 6G.
W88-00678

APPLICATION OF FIVE METHODS FOR MEASUREMENTS OF WILDLIFE VALUE: LOWER SHEYENNE RIVER BASIN NORTH DAKOTA,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
W. Nelson, W. Barker, and J. A. Leitch.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-290386. Price codes: A07 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, North Dakota State University, Fargo. Completion Report, January 1983. 133 p, 10 fig, 17 tab, 63 ref. Project No. OWRT B-030-NDAK (4).

Descriptors: *Wildlife, *Economics, *North Dakota, Population, Outdoor recreation, Wetlands environment, Habitats, Social values, Sheyenne River Basin.

Increasing attention has been focused on wildlife and the environment in recent years. This concern has been brought about by increased population, more leisure time, a better educated populus, and higher levels of pollution. Wildlife has been caught in a squeeze from two directions: diminishing habitat and increasing demand as an element of outdoor recreation. This study was to determine the economic value of wildlife of the Lower Sheyenne River Basin (LSRB). The components of this objective were (1) to describe the wildlife community of the LSRB and (2) to identify and apply alternative methods of determining values of wildlife in this area. Only 45% of the land is under cultivation, the remainder being either in woodland (10%) wetland (3%) or grazed (41%). It is the least densely populated reach of the LSRB, with many sections having no human inhabitants. It harbors a relative abundance of wildlife and possesses the potential for more. The wildlife community of the Lower Sheyenne River Basin has a positive economic value. Any plans for development of the basin should include a parameter for wildlife. The wildlife resources can be compared equitably against alternative land-uses by calculating economic values for that resource. (USGS)
W88-00741

HIPLEX: A COOPERATIVE PROGRAM ON RAIN AUGMENTATION IN THE HIGH PLAINS,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
For primary bibliographic entry see Field 3B.
W88-00788

GARRISON DIVERSION UNIT COMMISSION, FINAL REPORT.
Garrison Diversion Unit Commission, Bismarck, ND.
December 20, 1984. 59, 6 append.

Descriptors: *Water management, *Water resources development, Future planning, Water supply development, Potential water supply, Irrigation programs, Project planning, Environmental impact statement.

The Garrison Diversion Unit Commission was appointed by the Secretary of the Interior to review the controversy surrounding the authorized Initial Stage of the Garrison Diversion Unit, to evaluate the contemporary water needs of the State of North Dakota, and to make recommendations. The Commission members realized that the State of North Dakota needs a federally-funded water project for irrigation development, a moral commitment should be kept regarding the Upper Missouri Basin States and Indian Tribes, municipal and industrial water needs are important to a broad spectrum of groups throughout the State, construction of the Garrison Diversion Unit would be of serious concern to Canada, some environmental impacts of the initial stage of the authorized plan should be avoided, and existing wetlands should be protected. Based on these points, the Commission formulated an alternative plan, the Commission Plan, to avoid the problems sited in the initial plan. Following public hearings, the Commission decided to keep open future opportunities of the State to pursue irrigation and other development of the Hudson Bay drainage area and elsewhere in the State, to meet the needs of the greatest number of people at an acceptable cost, and to minimize environmental impacts. The revised Commission Plan provides irrigation service to about 130,000 acres. It proposes studies and consultations with Canadian officials to develop methods that would permit the use of Missouri River water under future proposals for irrigation in areas of North Dakota that lie in the Hudson Bay drainage. The Commission Report also contains several recommendations that expand significantly the availability of Missouri River water and groundwater to municipal, industrial, and rural supply systems. (Geiger-PTT)
W88-00830

ECOLOGICAL CHARACTERIZATION OF THE CENTRAL AND NORTHERN CALIFORNIA COASTAL REGION. VOLUME IV: WATERSHEDS AND BASINS, CHAPTERS 1-16.
Jones and Stokes Associates, Inc., Sacramento, CA.
For primary bibliographic entry see Field 2E.
W88-00900

ECONOMIC BENEFITS OF CONTROLLING WATER POLLUTION IN AN IRRIGATED RIVER BASIN: METHODOLOGY AND APPLICATION,
Washington State Univ., Pullman. Dept. of Agri-

cultural Economics.
Y. Gutema, and N. K. Whittlesey.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-164756. Price codes: A09 in paper copy, A01 in microfiche. EPA-600/2-83-008, February 1983. 169 p, 22 fig, 18 tab, 178 ref.

Descriptors: *Planning, *Economic evaluation, *Water quality control, *Irrigation, Cost-benefit analysis, Return flow, Flow augmentation, Social aspects, Nitrates, Agriculture, Nonpoint pollution sources, Fate of pollutants, Benefits, Yakima River, Washington, Fishing, Recreation, Standards, Water quality standards.

An analytical model consisting of a water quality submodel and an economic submodel was developed. The water quality submodel consisted of three elements: parameters, water quality index functions, and an aggregation rule. The parameters defined water quality as a multidimensional vector, with each component representing some aspect of the physical, chemical, biological, and aesthetic characteristics of water affecting water uses. The water quality index functions translated the measured levels of parameters into numerical values of quality levels which water users could interpret. The aggregation rule provided a way for combining the numerical values of water quality and parameters into an overall water quality index for each use. The economic submodel viewed water as a multiple use resource, with each use having its own quality requirements. Basically, this submodel provided estimates of aggregate net social benefits to be derived from water quality changes. The model was tested and demonstrated by application to three typical water quality improvement policies: stream flow augmentation, reduced sediment level, and reduced nitrate levels. The social benefits from flow augmentation exceeded the social benefits derived from policies reducing sediment or nitrate levels. For both stream flow augmentation and reduced nitrate levels, the annual benefits fell short of the annual costs at the highest level of water quality. These findings imply that water quality standards may be too high, and achieving these standards may not be economically efficient. (Author's abstract)
W88-00908

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DO WATER MARKETS 'WORK'. MARKET TRANSFERS AND TRADE-OFFS IN THE SOUTHWESTERN STATES,
Arizona Univ., Tucson. Dept. of Cellular and Developmental Biology.
For primary bibliographic entry see Field 6D.
W88-00022

FINANCIAL BURDENS AND ECONOMIC COSTS IN EXPANDING URBAN WATER SYSTEMS,
North Carolina Univ., Chapel Hill. Dept. of City and Regional Planning.
D. H. Moreau, and T. P. Snyder.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1139-1144, July 1987. 5 fig, 6 ref.

Descriptors: *Water supply development, *Cost allocation, *Water conveyance, *Economic aspects, *Costs, *Expansion, *User costs, Municipal water, Financing, Costs, Water distribution, Interest rates, Mathematical equations.

Rates of growth of demand, lengths of financing periods, real interest rates, and types of facilities are shown to be important variables in evaluating the equity (or inequity) between established residents and new-development residents when urban water and sewer facilities are expanded with public financing. Established residents pay less than the economic cost of facilities when facilities that can be efficiently expanded in an incremental manner are subjected to demands that are growing at rates that are less than the real interest rate. They pay more than the economic cost when growth occurs at higher rates. When facilities are expanded at multiyear intervals with excess capacity, payments are equated to costs at lower growth rates. Similarly, increasing real costs of facilities shift that breakpoint to lower growth rates. Modest one-time changes can be used to offset burdens on established residents when inequities do occur. Inflation has little effect on these results. (Author's abstract)
W88-00025

NEW METHOD FOR THE REAL-TIME OPERATION OF RESERVOIR SYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 4A.
W88-00046

SIMULATED IMPACT OF WEATHER MODIFICATION ON THE COLORADO RIVER,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
For primary bibliographic entry see Field 3B.
W88-00351

ECONOMIC EVALUATION OF ALTERNATIVE STRATEGIES FOR MAINTAINING INSTREAM FLOWS,
Utah Water Research Lab., Logan.
R. Narayanan, D. Larson, A. B. Bishop, and P. Amirfathi.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 621-639, 4 fig, 6 tab, 13 ref.

Descriptors: *Cost analysis, *Water law, *Water rights, *Rivers, *Instream flow, *Irrigation, *Water management, *Riparian rights, *Legal aspects, *Economic aspects, Blacksmith Fork, Little Bear River, Streamflow, Model studies, Water use, Water demand.

By using a stochastic linear programming model, the expected cost of maintaining various levels of expected instream flows was determined. Due to the difference in the values of junior and senior water rights, using an expected instream flow strategy produces a consistently lower cost as compared to a minimum flow strategy. At higher levels of expected instream flow requirements, the difference in costs between the two strategies narrowed. However, to maintain expected instream flows at 70% of average flows, the agricultural sector has to be virtually eliminated. One disadvantage of the expected instream flow strategy is that it could prescribe zero instream flows during certain short periods. Therefore, a critical instantaneous flow of 20% of average flows to prevent irreversible damages was stipulated. This critical flow strategy does not appreciably increase the cost of maintaining expected instream flows. The irrigated acreage is found to be fairly stable over most ranges of water availability for the simple expected instream flow strategy and the critical flow strategy. Under the minimum flow strategy, larger acreages of land may be irrigated under high stream flow conditions, but irrigated land generally drops to zero under low and medium stream flow conditions. Based upon these results, the critical flow strategy appears to be a promising criterion for providing instream flows. However, stream-specific costs of alternative expected instream flow requirement levels need to be determined before choosing a desired level of expected instream flow. (See also W86-02484) (Author's abstract)
W88-00369

ENERGY IMPACTS OF MAN-MADE WATER RECREATION AREAS,
Utah State Univ., Logan. Dept. of Mechanical Engineering.
D. A. Bell, J. C. Batty, E. B. Godfrey, J. P. Riley, and T. C. Stoddard.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 641-656, 4 fig, 5 tab, 22 ref.

Descriptors: *Cost analysis, *Economic aspects, *Energy, *Reservoirs, *Recreation, Construction costs, Travel, Lake Powell, Flaming Gorge, Willard Bay, Rockport Reservoir, East Canyon Reservoir, Hyrum Reservoir, Planning, Accounting.

Energy expenditures for water-based recreation sites in Utah were developed. The most significant facets of energy usage were construction of the facility, energy expended at the site in pursuit of recreation, and energy used in travel to and from the site. Energy expenditures for travel to and from the site and on-site were significantly more than construction energy expenditures. For Lake Powell the expenditures (in TJ) were 364 for construction, 3000 for travel, 976 on-site. For Flaming Gorge, Willard Bay, Rockport, East Canyon, and Hyrum, these expenditures were 2-61 for construction, 24-55 for travel to and from, and 26-55 for travel on-site. (See also W86-02484) (Cassar-PTT)
W88-00370

POTENTIAL COST SAVINGS FROM INVESTMENTS IN ENERGY-CONSERVING IRRIGATION SYSTEMS,
Battelle Pacific Northwest Labs., Richland, WA.
W. P. Patton, G. L. Wilfert, B. J. Harrer, M. A. Clark, and K. L. Sherman.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001799. Price codes: A10 in paper copy, A01 in microfiche. PNL-3930, UC-95f, October 1982. 179 p, 22 tab, 15 ref, append. Contract No. DE-AC06-76RLO 1830.

Descriptors: *Planning, *Water conservation, *Cost analysis, *Irrigation costs, *Energy costs, Conservation, Agriculture, Wells, Pumps, Computers, Irrigation efficiency.

Energy-conserving irrigation systems were compared with conventional systems of similar technology on the basis of energy use and energy, capital, operating and maintenance costs. Several techniques are recommended for information dissemination and commercialization: (1) improved well development--surged wells may have more potential for market development than jetted wells (these methods can only be used in new wells), (2) redesigned pump impeller and housing, (3) low-energy precision application (LEPA) center-pivot and lateral-move systems, and (4) computerized irrigation scheduling. Reduced-pressure center-pivot systems are already being marketed. (Cassar-PTT)
W88-00478

FINANCING WATER SUPPLY AND WASTEWATER SERVICES IN NORTH CAROLINA IN THE 1980S,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 5D.
W88-00735

GUIDELINES FOR ASSESSING FLOOD DAMAGE IN SOUTH AFRICA,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Social and Economic Research.
D. J. G. Smith, M. F. Viljoen, and P. H. Spies.
Published by South Africa Water Research Commission, Pretoria, 1981. 64 p, 7 fig, 1 tab, 25 ref, append.

Descriptors: *Planning, *Cost analysis, *Flood damage, *South Africa, Cost-benefit analysis, Damage, Flood plains, Flood data, Economic aspects, Compensation, Evaluation, Land appraisals, Pricing, Social aspects, Model studies, Property value, Real property, Farms, Livestock.

Research was conducted on guidelines for flood damage assessment in South Africa. These are designed as suggestions, not a final procedure, and should be adapted to individual situations. A procedure for measuring flood damage is concerned

with primary damages, secondary damages, and intangible damages. A detailed practical application shows how to identify individuals and institutions which sustained damage, to obtain secondary data such as market values, to survey the site, and to describe the damage in the following categories: land, crops and harvests, buildings, other fixed improvements, contents of dwellings, stock, vehicles and machinery, livestock, and miscellaneous, for example, higher telephone expenses, loss of business, and extra pay for municipal workers. A 37-page appendix shows questionnaires useful in obtaining flood damage data. (Cassar-PTT)
W88-00832

1982 NEEDS SURVEY: COST ESTIMATES FOR CONSTRUCTION OF PUBLICLY-OWNED WASTEWATER TREATMENT FACILITIES.
Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-148486. Price codes: A05 in paper copy, A01 in microfiche. December 31, 1982. 85 p, 10 tab, 3 append.

Descriptors: *Wastewater facilities, *Cost analysis, *Surveys, *Cost allocation, *Wastewater management, Wastewater treatment, Construction costs, Economic aspects, Combined sewer overflows, Combined sewers, Wastewater collection, Future planning, Management planning.

The 1982 Needs Survey gives the best estimate available of the nationwide costs of compliance with the goals of the 1981 Construction Grant Amendments to the Clean Water Act (CWA). Meeting the water quality goals of the CWA will require a substantial investment. Total existing and proposed treatment and interceptor needs, including growth to the year 2000 are estimated at $57.3 billion. Advance work completed during the 1982 Needs Survey will provide the foundation for linking treatment plants with their receiving water bodies and water quality impacts as part of the 1984 Needs Survey. Absolute backlog and year 2000 needs have decreased by about 13.1% and 15.3%, respectively, since the 1980 Needs Survey. For the first time, the need for treatment of combined sewer overflows (CSO) was based on an estimate of the costs to achieve the State designated stream use classification rather than on an assumed recreation use for each CSO area. About 16% of the national population is currently served by CSOs. The quality of the 1982 Needs Survey estimates has been greatly improved. Needs Survey data provide a basis for congressional allotment of funds appropriated for the construction grants program. The 1982 Needs Survey includes a preliminary analysis of the future Federal share of treatment works cost (an estimated $37.3 billion). As an addendum to the 1982 Needs Survey, EPA will provide a complete list of marine areas with combined stormwater and sanitary sewer overflow problems and their estimated costs. (Geiger-PTT)
W88-00917

6D. Water Demand

DO WATER MARKETS 'WORK'. MARKET TRANSFERS AND TRADE-OFFS IN THE SOUTHWESTERN STATES,
Arizona Univ., Tucson. Dept. of Cellular and Developmental Biology.
B. C. Saliba.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1113-1122, July 1987. 1 fig, 44 ref.

Descriptors: *Water markets, *Water rights, *Economic aspects, *Water allocation, *Water management, Economic aspects, Southwest, United States, Resource allocation, Water use, Water demand.

Five southwestern water markets are described. Market processes were evaluated using transactions data from each study area. While the evaluation is necessarily preliminary due to the limited availability of data on market transactions, the markets analyzed appear to be relatively efficient in allocating water between municipal and agricultural uses. However, nonconsumptive use water values and third-party impacts not specifically addressed in state laws are poorly accounted for in most areas. Trade-offs between benefits of market activities, opportunity costs related to market transfers, and transactions costs induced by laws and institutions are identified. These trade-offs are a key issue facing policymakers who determine the roles that market and administrative processes play in water allocation. (Author's abstract)
W88-00022

INFLUENCE OF SOCIAL FACTORS ON PUBLIC ACCEPTANCE OF RENOVATED WASTEWATER,
California Univ., Irvine. Program in Social Ecology.
B. H. Olson, and W. Bruvold.
In: Water Reuse, Ann Arbor Science, Ann Arbor, MI, 1982. p 55-73, 1 fig, 1 tab, 29 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Public opinion, Wastewater, Wastewater management, Wastewater renovation.

The importance of public opinion in determining and implementing policy for use of renovated wastewater is an extremely timely and interesting issue. Water as a resource has increasingly gained attention in water-short areas of the Southwestern and Northwestern United States. The purpose of this paper is to present several aspects of the influence of social factors on public acceptance of water reuse. The most widely accepted forms of water reuse fall in to the category of noncontact uses, such as park and golf courses, garden irrigation, scenic lakes, factory/cooling process, boating and fishing, toilet, and farm irrigation. Body contact categories, such as laundry, beaches and bathing are not as acceptable as non-contact uses. The least acceptable category is cooking, food canning and drinking. Such factors as sociodemography and the role of government are also discussed. The primary conclusion reached is that reuse projects that have the greatest chance for success ought to produce more actual adoptions of advanced uses of reclaimed water. (See also W88-00164) (Halterman-PTT)
W88-00167

IMPLEMENTING DIRECT WATER REUSE,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-00175

WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE.
Available from the National Technical Information Service, Springfield, VA 22161, as PB86-153046/AS. Price codes: A22 in paper copy, A01 in microfiche. University of California Press, Berkeley. 1984. Edited by Ernest A. Engelbert and Ann Foley Scheuring. 500 p.

Descriptors: *Water supply, *Water scarcity, *Water conservation, *Water demand, *Irrigation water, *Agricultural water, Planning, Agriculture, Water policy, Water rights, Water management, Conservation, Irrigation.

A collection of papers on the scarcity of agricultural water in the western U.S. considers four major topics: Part I, water availability for agriculture; Part II, alternatives for satisfying agricultural water demands; Part III, impacts of less water for irrigated agriculture; and Part IV, strategies for maintaining agricultural viability with limited water supply. Part I gives an overview of water availability from hydrological, institutional, and economic perspectives. The alternatives in Part II include developing new supplies, increasing efficiency of nonagricultural use, managing soil salinity, and improving current farm management methods. Part III shows the effects of limited water supplies on regional and local economies, the national commodity system, the business community, rural communities, urban communities, and the environment. Strategies mentioned in Part IV show how various interests can help maintain agricultural viability--farmers, business and financial interests, and government. (See W88-00292 thru W88-00313) (Cassar-PTT)
W88-00291

NO SIMPLE SOLUTIONS,
A. F. Scheuring, E. A. Engelbert, and R. M. Hogan.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 1-16.

Descriptors: *Planning, *Agriculture, *Water supply, Water scarcity, Water policy, Water rights, Water management, Water conservation, Conservation, Irrigation.

This introductory chapter on the scarcity of irrigation water in the West defines this geographical area and its climate and describes its history as it affects the water supply problem. As water supplies dwindle and demand increases, a new era is at hand. The issues and choices are summarized. Planning the future of water in the West is difficult for several reasons. Nevertheless, some planning is necessary. If assumptions prove false, adjustments can be made. Suggested actions include (1) research and information gathering, (2) widespread adoption of efficient and cost-effective water management and conservation, (3) water development in specific locations, (4) more capital for long-range management goals, (5) consideration of environmental and social needs, (6) innovation in interorganizational planning, particularly at the local level, (7) removal of institutional barriers, (8) more collaboration between federal and states in project management and policy, and (9) more cooperation among interest groups representing water users. (See also W88-00291) (Cassar-PTT)
W88-00292

PHYSICAL LIMITATIONS OF WATER RESOURCES,
J. Bredelhoeft.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 17-50, 19 fig, 3 tab, 15 ref.

Descriptors: *Planning, *Water supply, *Groundwater mining, *Agriculture, Groundwater depletion, Water use, Hydrologic cycle, Irrigation, Water management, Water scarcity.

Man's influence is an integral part of the hydrologic cycle. Groundwater mining decreases the amount of water in transit in the hydrological cycle and produces potential future shortages. Groundwater mining is extensive in the southwestern U.S., where urban movement and energy development compete with agriculture for the available supply. Where water is fully appropriated, increased supplies for urban development and industry must come from agriculture. Severe competition will force choices between the various uses: irrigation, streamflows for fish, domestic needs, etc. (See also W88-00291) (Cassar-PTT)
W88-00293

COMPETITION FOR WATER,
K. D. Frederick, and A. V. Kneese.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 81-108, 1 fig, 5 tab, 15 ref.

Descriptors: *Planning, *Water supply, *Water demand, *Agriculture, Irrigation, Water scarcity, Water use, Yampa River, Appropriation, Institutional constraints, Water management, Second National Water Assessment, Economic aspects, Water shortage, Water rights, Energy development, Industrial water, Environmental effects.

The growing scarcity of water in the West already has curbed the expansion of irrigated agriculture and promises to impose further constraints in the coming decades. Nevertheless, declines in irrigated acreage will be limited to the most water-scarce areas and will tend to be modest in scale. Since irrigation now accounts for about nine out of every ten gallons of water consumed in the West, large percentage increases in consumption for other uses can be accommodated with small relative reduc-

tions in agricultural uses. Opportunities for conserving water and increasing output per unit of water will further limit the negative impacts on irrigated agriculture. There are areas where water supplies are sufficient to support an expansion of irrigation. For the West as a whole, the Second National Water Assessment projects increases of 10% in irrigated acreage and 6% in water consumed for irrigation from 1975-2000. Some of the adjustments which have only marginal impacts within specific locations. The point is illustrated by examining the potential impacts of energy development on the character and beauty of the Yampa River. Full appropriation of water supplies presents a major challenge to the institutions allocating western water. If these institutions permit flexibility of use in response to changing demand and supply conditions, water will not be a barrier to either agricultural or nonagricultural development in the West. (See also W88-00291) (Author's abstract)
W88-00295

DEVELOPING NEW WATER SUPPLIES,
H. O. Banks, J. O. Williams, and J. B. Harris.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 109-132, 7 ref.

Descriptors: *Planning, *Water supply, *Water demand, *Agriculture, *Water transfer, Water scarcity, Water use, Yampa River, Water conservation, Irrigation, Water diversion, Rocky Mountain Plain, North American Water and Power alliance, Western States Water Augmentation Concept, Interbasin transfer, Weather modification, Columbia River basin, Missouri River basin, Mississippi River, Water harvesting, Desalination.

The inadequacy or maldistribution of water supplies for agricultural and other water users throughout most of the western U.S., has historically been a focus of attention for the local citizenry, for water planners and developers, engineers, conservationists, economists, promoters and others concerned with the future of the region. This paper looks at the potential for developing alternative water supplies for the region, with special emphasis on meeting the future water needs of the agricultural sector. Prospects for importing excess surface waters into the region, either from international or domestic sources, are examined along with several local water enhancement or augmentation potentials. Weather modification, water harvesting/water banking techniques, desalination and/or use of saline water supplies, water reclamation and reuse, surface/groundwater management, improvements in operation of existing projects to increase yields, and other prospects for local water supply enhancement are discussed. General conclusions are that the probabilities for large-scale new water supplies or developments for the region in the foreseeable future are not great. The potentials for significant breakthroughs in local water supply enhancement or any large-scale water importation for the semiarid West are limited. (See also W88-00291) (Author's abstract)
W88-00296

NATIONAL AND INTERNATIONAL COMMODITY PRICE IMPACTS,
E. O. Heady.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 273-298, 3 tab, 29 ref.

Descriptors: *Planning, *Water supply, *Pricing, Agriculture, Water scarcity, Food prices, Crop yield, Economic aspects, Irrigation, Elasticity of demand.

Reduced supplies and higher costs for water in the future will lead to higher food costs. However, these tendencies cannot be separated from other variables which also will cause higher prices for food. Major variables affecting food prices include world population, per capita income, and agricultural technology in developing countries. Developing countries have capabilities to produce enough food to keep real prices at reasonable levels. These outcomes will overshadow U.S. water supplies in determining future food prices. Another condition of similar importance in food prices is the general level of agricultural technology in the U.S. Some agriculturalists believe that crop yields are plateauing. If so, these yield limits would dominate water supplies in affecting food prices. However, other agricultural scientists foresee technological advances in crop and livestock production which will entirely offset water supplies in determining U.S. food prices over the next 30 years. Statistical models to predict the impact of water supplies on food prices do not exist. However, a programming model providing a normative analysis indicated that reduced water supplies which cause a fourfold increase in water prices would increase food prices by 6%. Reduced water supplies in combination with restraints on land use and soil loss would cause much higher increases in real costs of food. Based on estimated food demand elasticities, each 1% decline in food supplies due to reduced water availability would increase food prices by 4% in terms of domestic conditions and 0.75% in terms of world markets. (See also W88-00291) (Author's abstract)
W88-00303

IMPACTS UPON BUSINESS COMMUNITIES,
V. M. Crowder.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 299-308, 1 tab, 1 ref.

Descriptors: *Planning, *Water supply, *Agriculture, Irrigation, Water scarcity, Political constraints, Water demand, California, Pricing, Water resources development, Water rights, Water conservation, Costs, Water use.

The probable impacts of limited water supplies on agribusiness, banking, and the resulting effects on the economy are examined with emphasis on California. Several assumptions are made: (1) world demand for food will increase, (2) energy prices will rise, (3) capital costs for water supply development will rise, (4) further significant conservation in agriculture is difficult, (5) transfer of water rights will be very difficult, (6) urban water use will increase, and (7) political constraints will continue to impede progress in additional water development. Impacts of limited water supplies include reduction in agricultural production, increase in land values, and improvement in irrigation efficiency. The overall picture is bleak. Although additional water development would help alleviate some of the problems, this is unlikely because of political in-fighting among agricultural interests. (See also W88-00291) (Cassar-PTT)
W88-00304

WHAT FINANCIAL AND BUSINESS INTERESTS CAN DO,
A. L. Black.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 396-407, 2 ref.

Descriptors: *Planning, *Water supply, *Economic aspects, *Water conservation, *Agriculture, Irrigation, Research, Financing, Water scarcity.

Opportunities for improved soil and water conservation, increased water and energy use efficiencies are dependent upon further advances in agricultural research. Without an adequate profit margin, farmers and ranchers cannot justify soil and water conservation. Financial institutions must be aware of current research, development, and demonstration in order to assist the farmer in financing. Consumers must be willing to support public funding for water conservation research and for water supply development. Farmer, banker, and businessman are independent upon each other; the general public is dependent upon the agricultural community. The public can greatly influence the viability of agriculture. (See also W88-00291) (Author's abstract)
W88-00309

PROBLEMS, FINDINGS, AND ISSUES,
G. F. White.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 472-484, 1 fig, 1 tab.

Descriptors: *Water supply, *Agriculture, Water scarcity, Irrigation, Water management, Water conservation, Water policy.

Authors contributing papers to this collection show consensus as well as divergence on the problem of limited water for irrigated agriculture in the West. Most agree that no immediate crisis in water supply looms, except where groundwater is rapidly being depleted. Changes are likely to be slow and gradual. Climate is expected to become warmer and dryer. Opportunities for increasing water supply or storage are limited. Groundwater is being depleted at radically different rates. Competition between agricultural and municipal-industrial users is increasing; water rights manipulation is controlling this. Further water conservation in agriculture is possible, but not always economically feasible. Some adverse effects of dwindling agricultural water supplies are continuing salinization of soil, abandonment of irrigated land and resulting wind erosion, and socioeconomic damage to rural communities. However, urban centers and the national economy are not expected to suffer from reductions in irrigated agriculture. Several areas of doubts and disagreements among the authors are listed as questions. Five issues are identified. (1) Territorial identity limits the transfer of water among states or basins. (2) Uncertainty that events will proceed as predicted (example, very severe drought persisting over a decade influences policy choice). (3) The balance between market mechanisms and government regulation will never be fully resolved. (4) In the country as a whole and, in particular in the semiarid West, public emphasis is shifting toward conservation and away from new resource development. (5) The lack of a real feeling of crisis may result in a short-sighted view of the problem. (See also W88-00291) (Cassar-PTT)
W88-00313

COLORADO, A RIVER FOR MANY PEOPLE,
Bureau of Reclamation, Boulder City, NV.
B. Plummer.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 3-11.

Descriptors: *Water demand, *Water use, *Water management, *River basin development, *Water allocation, Colorado River, River basin development, Water law, Water rights, Regulated flow, Lake Powell, Lake Mead, Reservoirs, Saline water, Irrigation, Hydroelectric power, Flood control, Recreation, Mexico, Wildlife.

The Colorado River, 1400 miles long, is the primary source of water for much of its 244,000 sq mi basin. Labeled the world's most regulated river, it is used for irrigation, municipal and industrial purposes, hydroelectric power generation, fish and wildlife enhancement, recreation, and interbasin export. The major legislation affecting the river includes the Colorado River Compact (1922), the Boulder Canyon Project Act (1928), a treaty with Mexico (1944), and the Upper Colorado River Compact (1948). Under the Colorado River Basin Project Act, operation of the reservoirs is coordinated under these criteria: to maintain a minimum release of 8.23 million acre-feet of water from Lake Powell annually, to develop an operating plan for the river annually, and to provide all reasonable consumptive use requirements in the Lower Basin until the Central Arizona Project has been completed. When releases in excess of requirements are made, the water is put to work for power generation, leaching salts, double cropping, and extra irrigation. A salinity control act, signed in 1974, provides for removal of enough salt to make the water acceptable for delivery in Mexico. Future management of this highly complex river system must consider probable shortages and conflicts of interest among the many users. (See also W86-02484) (Cassar-PTT)

W88-00339

LONG-RUN FORECASTING OF REGIONAL ECONOMIC ACTIVITY FOR USE IN WATER RESOURCE PROJECT EVALUATIONS,
Ohio State Univ., Columbus. Museum of Zoology.
For primary bibliographic entry see Field 6B.
W88-00549

NATIONAL WATER SUMMARY 1985 - HYDROLOGIC EVENTS AND SURFACE-WATER RESOURCES.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W88-00556

COST OF WATER IN WESTERN AGRICULTURE,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 3F.
W88-00638

WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE.
Available from the National Technical Information Service, Springfield, VA 22161, as PB86-153046/AS. Price codes: A22 in paper copy, A01 in microfiche. University of California Press, Berkeley. 1984. Edited by Ernest A. Engelbert and Ann Foley Scheuring. 500 p.

Descriptors: *Water supply, *Water scarcity, *Water conservation, *Water demand, *Irrigation water, *Agricultural water, Planning, Agriculture, Water policy, Water rights, Water management, Conservation, Irrigation.

A collection of papers on the scarcity of agricultural water in the western U.S. considers four major topics: Part I, water availability for agriculture, Part II, alternatives for satisfying agricultural water demands; Part III, impacts of less water for irrigated agriculture; and Part IV, strategies for maintaining agricultural variability with limited water supply. Part I gives an overview of water availability from hydrological, institutional, and economic perspectives. The alternatives in Part II include developing new supplies, increasing efficiency of nonagricultural use, managing soil salinity, and improving current farm management methods. Part III shows the effects of limited water supplies on regional and local economies, the national commodity system, the business community, rural communities, urban communities, and the environment. Strategies mentioned in Part IV show how various interests can help maintain agricultural viability–farmers, business and financial interests, and government. (Cassar-PTT)
W88-00650

PROJECTIONS OF WATER AVAILABILITY IN THE LOWER RIO GRANDE, GILA-SAN FRANCISCO AND MIMBRES DRAINAGE BASINS TO 2005,
New Mexico Univ., Albuquerque. Bureau of Business and Economic Research.
J. C. Tysseling, D. Boldt, and B. MacDonald.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201042/AS. Price codes: A09 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 212, October 1986. 172 p, 44 tab, 2 maps, 36 ref, 3 app. Project No. 1345629.

Descriptors: *Water demand, *Forecasting, *Water requirements, *Long-term planning, Regional analysis, Competing uses, Water policy, Management, New Mexico, Lower Rio Grande, Gila-San Francisco drainage basin, Mimbres drainage basin.

The management of New Mexico water resources requires an understanding of the magnitude and source of future water scarcity conditions. Without detailed information regarding the specific nature of future water scarcity conditions, resource management activities may incorrectly assign priorities to particular scarcity-mitigating efforts. Current and projected water supply and demand conditions are analyzed for the Lower Rio Grande Surface Drainage Basin the Gila River and San Francisco River Surface Drainage Basin and the Mimbres Closed Basin. This analysis relies on 1980 data and projects future water scarcity conditions over a 25-year period to 2005. Water use data for 1980 provided by the State Engineer Office is combined with economic and demographic data (from several sources) to allow calculation of water use coefficients for differing water use sectors within the hydrologically defined portions of each county. Future water scarcity conditions are assessed at both the county and basin-wide level in relation to existing water supplies identified by the State Engineer Office. The analysis identified increased water scarcity conditions in the projection for both the Lower Rio Grande Surface Drainage Basin and the Mimbres Closed Basin. The 25-year projection of water resource demands in the Gila-San Francisco Surface Drainage Basin shows a decline in scarcity conditions. (McDonald-NM U.)
W88-00717

INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE: REVIEW OF NATIONAL BASELINE DATA (AS AT 31 DECEMBER 1980).
World Health Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 5F.
W88-00878

SPECIAL GROUNDWATER STUDY OF THE UPPER DELAWARE RIVER BASIN, STUDY AREA II, VOLUME II, (CHAPTERS 8-11),
Delaware River Basin Commission, Trenton, NJ.
For primary bibliographic entry see Field 2F.
W88-00922

WATER RECYCLING IN THE FRUIT AND VEGETABLE PROCESSING INDUSTRY,
Montgomery (James M.), Inc., Walnut Creek, CA.
L. L. Russell, C. Creson, and K. Conarrol.
California State Water Resources Control Board, Office of Water Recycling. March 1981. 158 p, 28 fig, 27 tab, 165 ref, 5 append.

Descriptors: *Recycling, *California, *Food processing industry, *Water supply, *Water demand, *Water conservation, Economic feasibility, Research priorities, Trade associations, Wastewater treatment, Diseases, Industrial water, Water use, Case studies, Cost analysis, Federal jurisdiction, Water quality standards, Standards.

Because of the economic importance of the fruit and vegetable industry to California, it is vital to ensure a reliable water supply permitting continued and increased operation for the industry. The food processing industry is the largest industrial consumer of freshwater in the state, using approximately 84 billion gallons per year. The fruit and vegetable processing segment accounts for approximately 40% of this demand. Recycling food processing water within the industry could significantly reduce freshwater demand, thereby aiding in conservation of the water supply. Reported success with recycling has indicated that savings of 50-70% in water usage are attainable. Data collection on water recycling was performed by literature review, data collection from processors, review of existing recycle projects, and review of current research. Case histories are presented to provide information on what is being done within the industry. The technology for cost-effective recycling exists, but delays in implementation have resulted from the uncertainty of the health effects, the potential effects on product quality, the clouded definition of areas of authority of regulatory agencies, the complex federal standards, and indecision on standards for effluent and in-plan water quality. The rapidly escalating processing costs, reflected in consumer prices, have led to evaluation of methods to reduce costs and remain competitive. (Fazio-Omniplan)
W88-00925

WATER RESOURCES PROGRAM DRAFT,
Delaware River Basin Commission, West Trenton, NJ.
S. D. Seltzer.
October 1983. 52 p, 9 tab, 5 fig, 15 ref, append.

Descriptors: *Water resources development, *Delaware River, *Water development, *Resources development, *River basin development, Flow augmentation, Water reuse, Water renovation, Reservoir storage, Water storage, Storage, Water use.

Increased water demands in the Delaware River Basin include those for water supply, water-quality improvement, energy, stream-flow regulation, flood loss reduction, fish and wildlife protection, recreation, and preservation and enhancement of environmental quality. During periods of normal precipitation, there is adequate water in the Basin to meet needs. Most water used within the Basin is returned after treatment and becomes available for reuse. The sustainable June-September average flow of the river at Trenton, New Jersey, under 1980 uses and 1960s drought conditions is estimated at 2,587 cfs. Under a recurrence of the 1960s drought conditions, 1980 reservoir storage capacity in New York City's reservoirs cannot meet the terms of the U.S. Supreme Court decree of 1954 with respect to both exportations to New York City and downstream releases to the Delaware River. There is a need to augment flows in the river and major tributaries to offset depletive water uses and to protect instream uses. The quality of non-tidal streams throughout the Basin is generally adequate for uses requiring high levels of water quality, such as the dissolved oxygen content above 5.0 mg/l, pH between 6.5 and 8.5, and total dissolved solids less than 150 mg/l. However, portions of the Delaware Estuary from Trenton, New Jersey, to below Wilmington, Delaware, are still substandard in terms of dissolved oxygen and fecal coliform concentration. A basinwide flood loss reduction plan is also to be developed. (Hawkins-Omniplan)
W88-00929

6E. Water Law and Institutions

DO WATER MARKETS 'WORK'. MARKET TRANSFERS AND TRADE-OFFS IN THE SOUTHWESTERN STATES,
Arizona Univ., Tucson. Dept. of Cellular and Developmental Biology.
For primary bibliographic entry see Field 6D.
W88-00022

LEGAL AND INSTITUTIONAL CONSIDERATIONS IN WATER REUSE,
Denver Research Inst., CO. Industrial Economics Div.
For primary bibliographic entry see Field 5G.
W88-00166

FEDERAL INCENTIVES AND REQUIREMENTS INFLUENCING WASTEWATER REUSE,
Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
For primary bibliographic entry see Field 5G.
W88-00168

LEGAL-INSTITUTIONAL LIMITATIONS ON WATER USE,
G. Weatherford, and H. Ingram.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 51-80, 4 fig, 25 ref.

Descriptors: *Planning, *Legal aspects, *Water rights, *Institutional constraints, *Agriculture, Water law, Irrigation, Water use, Appropriation, Water allocation, Political constraints, State jurisdiction, Federal jurisdiction, Water conservation, Water management, Water scarcity.

In the western U.S. water reallocation and management is gradually replacing water development.

Irrigated agriculture's favored legal and political position is declining slightly. This change is likely to continue to be incremental, but more innovative change caused by unexpected events is possible. With this uncertainty more flexible water management institutions, which would promote conservation and water transfer, are advisable. As water available for agriculture declines, the prior appropriation system of water rights can be expected to (1) aid the farmer who wants to profit from the sale of water rights to other users, (2) compensate the farmer whose land and water is condemned against his wishes, (3) encourage water conservation, (4) permit holders of junior rights to be displaced by holders with senior rights, and (5) provide a cause of action for farmers whose water rights are impaired by late-comer appropriators. At present the states' influence in water management is increasing as the federal government's role is decreasing. (See also W88-00291) (Cassar-PTT)
W88-00294

WATER RIGHTS AND MARKET TRANSFERS,
F. L. Brown, and C. T. DuMars.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 408-436, 39 ref.

Descriptors: *Water law, *Waters rights, Institutional constraints, Water scarcity, Water demand, Economic aspects, Water management, Social aspects, Legal aspects, Diversion, Return flow, Judicial decisions, Water conservation.

Western water institutions are moving from a period of water development into an era of water management in which water reallocation, water conservation, and water quality enhancement will play increasingly greater roles relative to traditional development projects. Faced with new tasks to be performed, existing institutions are changing and new ones developing. Economic considerations are forging marketlike institutions, and the courts are expediting this evolutionary process by broadening the spectrum of persons who have a stake in water rights transfers and insisting on more efficient use of water. However, it is unlikely that society will accept an unbridled marketplace allocation of water; it will instead choose between increased regulation at the state level or increased ownership at the local level, with the former assigned the higher probability. (See also W88-00291) (Author's abstract)
W88-00310

ONE STATE'S STRATEGY FOR PUTTING WATER TO BENEFICIAL USE,
T. Schwinden.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 437-444.

Descriptors: *Water law, *Agriculture, *Water supply, *Water demand, *Water rights, Montana, Water scarcity, Legal aspects, Irrigation, Adjudication procedure, Beneficial use, Diversion, Instream flow, Water management, State jurisdiction.

Increased use and competition for water have made shortages and conflicts today's realities in many of Montana's drainages. Montana has begun the implementation of a water resource management program to ensure adequate water supplies for Montanans, both now and in the future. The program has four basic elements. (1) A water adjudication system to document water rights acquired before 1973. Another objective of the adjudication program is to quantify Indian and non-Indian federal reserved water rights. (2) A study authorized by the legislature to determine how much water will be needed for beneficial use in Montana. The study also examines how potential future water development in Montana may be constrained by downstream water claims. (3) A water reservation system that allows agencies to apply to the state to reserve water for anticipated diversionary future uses or to maintain a minimum flow, level, or quantity of water instream. (4) A water development program which makes state funding available for water projects. Funds for the projects come from several sources, including the Resource Indemnity Trust and revenues from existing state water projects. The program also authorizes low-interest loans and grants to fund public and private water projects, and provides a $250 million bonding authority to implement water projects developed by the state and approved by the legislators. (See also W88-00291) (Author's abstract)
W88-00311

FEDERAL WATER POLICIES AND IRRIGATED AGRICULTURE,
G. E. Carruthers, T. G. Bahr, H. H. Fullerton, and N. H. Starler.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 445-471, 20 ref.

Descriptors: *Water policy, *Agriculture, *Water supply, Water scarcity, Irrigation, Federal jurisdiction, Legal aspects, Pricing, Water allocation, Economic aspects, State jurisdiction, Water management.

The administration's (Reagan) policy on water rights states that control of the nation's water resources is a state's rights. Primacy in water allocation and management decisions will also continue to be the state's responsibility. Both state and federal water policy have produced market distortions and reduced use efficiency and value of water resources. Allocation of present and future water resources is best handled by markets which function without unnecessary interference from the public sector. Market distortions which are federal responsibility should be identified and removed. The federal role should be one of cost sharing with the states in cases where significant federal interests are involved. Multiobjective projects will be increasingly limited and difficult to justify. The states will also be responsible for research in nontraditional technologies. In the semiarid West the agricultural sector will continue to be strong and viable as long as water markets operate effectively. Price incentives and increases in water resources values will control water resource use. In the long term higher water resource values in agriculture should provide an adequate asset base and appropriate incentive to use more efficient technologies, improved genetic materials, and more efficient management. (See also W88-00291) (Cassar-PTT)
W88-00312

WATER POLLUTION LAW,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
IN: Environmental Pollution and Control, 2nd edition. Butterworth, Boston, MA. 1983. p 141-151, 4 tab.

Descriptors: *Water law, *Water rights, *Standards, *Legal aspects, Appropriation, Common law, Regulations, Permits, Riparian rights, Water pollution control, Prescriptive rights, Water quality, Drinking water.

Water pollution laws are based on both common law and statutory law. In common law the riparian doctrine says that conflicts between two parties must be decided by the ownership of the land underlying or adjoining a body of surface water. The prior appropriations doctrine states that water use is rationed on a first-come first-served basis, regardless of land ownership. In urban settings the riparian doctrine was not workable. Thus developed the principle of reasonable use and the concept of prescriptive rights. Other developments in the common law are the appropriations doctrine (first in time/first in line). Statutory laws have been passed to control water pollution. Among these are the Water Quality Act, the Federal Water Pollution Control Act, the National Pollutant Discharge Elimination System, and the Clean Water Act. Pretreatment guidelines have been developed by the EPA. The Safe Drinking Water Act specifies physical, bacteriological, and chemical standards for drinking water. (See also W88-00314) (Cassar-PTT)
W88-00337

HEADWATERS VIEW OF CLOUDSEEDING IN THE COLORADO RIVER BASIN,
Colorado Dept. of Natural Resources, Denver.
B. C. Welles.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 195-209, 1 tab, 17 ref.

Descriptors: *Water law, *Water supply development, *Weather modification, *Cloud seeding, *Snow, Colorado River, Legal aspects, Licenses, Permits, Recreation, Public opinion, Water policy.

Colorado passed the first law regulating cloud seeding in 1951. The current laws provide for a state advisory committee and for licensing and permits before a specific cloud seeding project. Cloud seeding without permit is a felony in the state. The permit has certain requirements with respect to objective, education, public hearings, and provision for suspension if snow cover is too deep or if traveling, road maintenance, and wildlife can experience severe problems. During the years 1977-1981 a total of 31 licenses, 16 commercial permits (ski areas, recreation groups, resorts, municipal water providers, etc.), and 3 research permits were granted. Seeding is done in winter in mountains above the 2896-meter elevation. Controversy is always generated by cloud seeding--water users and ski areas favoring the seeding; ranchers, high-mountain communities, and persons opposed to fooling with nature, opposing seeding. Continued interest in cloud seeding is assured in Colorado because 70% of the seedable terrain of the river basin is in the state. Demands for augmenting river flow will certainly consider this alternative. (See also W86-02484) (Cassar-PTT)
W88-00349

PROJECTED IMPACTS ON WATER RIGHTS, WATER LAWS AND POLICY STIMULATED BY ENERGY DEVELOPMENT AND OTHER PRESSURES,
Weber State Coll., Ogden, UT. Dept. of Political Science.
A. B. Davis.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 599-619, 1 tab, 23 ref.

Descriptors: *Water law, *Water rights, *Water policy, *Energy, *Legal aspects, Riparian rights, Arid regions, Water use, Federal jurisdiction, Instream flow.

A water rights revolution occurred in the western United States when the first settlers arrived because the riparian doctrine did not apply to the environment and needs of this region. The availability of water will be a limiting factor on energy development. Additional factors are Indian and federal reserve water rights. Expected to grow are the demand to reserve water for instream flows and the effort to extend the use of the public interest doctrine. All these opposing interests will produce extensive changes in water use, water rights, and water policy. (See also W86-02484) (Cassar-PTT)
W88-00368

ASSESSMENT OF SELECTED LEGAL/INSTITUTIONAL CONSTRAINTS TO WATER CONSERVATION IN THE WESTERN STATES (A SUMMARY VERSION),
Teknekron Research, Inc., Berkeley, CA.
R. J. Glickstein.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207122/AS. Price codes: A03 in paper copy, A01 in microfiche. Completion Report, February 1983. 22 p, 4 tab. Project No. OWRT C-20019-T(2423)(1). Contract No. 14-34-0001-2423.

Descriptors: *Legal aspects, *Institutional constraints, *Water conservation, *Salvaged water, Water transfer, Water rights, Beneficial use, Western United States.

This summary document should be of interest to any researchers and policy makers in the water resource community who have a background in, or are concerned with, agricultural water conservation and the legal/institutional problems associated with conserving western water. There is emphasis in this summary version on the study design, the methodology, the technical findings and on additional research needs. This document suggests how decision makers can begin to implement the study's recommendations. (See also W87-07305) (USGS)
W88-00538

DISTRIBUTING THE RISKS OF INTERBASIN WATER TRANSFERS UNDER DROUGHT CONDITIONS: THE DILEMMA POSED BY COAL SLURRY PIPELINES (A SUMMARY VERSION),
Teknekron Research, Inc., Berkeley, CA.
R. J. Glickstein.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207056/AS. Price codes: A03 in paper copy, A01 in microfiche. Completion Report, February 1983. 23 p, 1 fig. Project No. OWRT C-20020-T(2424) (1). Contract No. 14-34-0001-2424.

Descriptors: *Interbasin transfers, *Coal slurry pipelines, *Risks, *Water scarcity, Water transfer, Pipelines, Western States, Arid lands, Legal aspects, Water allocation, Water use, Water law, Water rights.

This summary document should be of interest to any researchers and policy makers in the water resource community who have a background in, or are concerned with, problems associated with the use of western water for energy-related projects. There is emphasis in this summary version on the study design, the methodology, the legal findings and on additional research needs. This document suggests how decision makers can begin to implement the study's recommendations. (See also W82-06365) (Glickstein-Teknekron)
W88-00539

GROUND WATER MANAGEMENT UNDER THE APPROPRIATION DOCTRINE, PART I,
Idaho Univ., Moscow. Dept. of Geology.
D. Ralston, and E. Bruhl.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197349/AS. Price codes: A03 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow. Completion Report, July, 1986. 25 p, 4 fig. Contract No. 14-08-0001-G1014. Project No. USGS G1014-03.

Descriptors: *Groundwater management, *Appropriation doctrine, *Water rights, *Adjudication procedure, *State jurisdiction, Idaho, Oregon, Washington, Montana, Legal aspects, Pacific Northwest U.S.

A preliminary analysis is presented of groundwater management activities under the appropriation doctrine in Idaho, Oregon, Washington, and Montana. Groundwater management areas have been designated in each state in response to water level declines or water rights disputes. Recharge and pumping lift management tools have not been applied in most areas. Research completed to date allows identification of a range of applications of the appropriation doctrine to groundwater. Designation of an area as critical is common to the states investigated. A difference exists between whether the state or local individuals initiate the designation process. All states note the importance of adjudication of rights in the groundwater management process. Adjudications have been completed only for several areas. The Cottonwood area of Idaho is the only area where application of the recharge limitation has followed adjudication of rights. Most of the state water resource administrators indicated a reluctance to declare an area critical or initiate an adjudication without some local input or support. The Blue Gulch area of Idaho is an example where a state initiated adjudication was stopped because of local opposition. The Butter Creek area in Oregon has been declared critical by the state three times only to have the order repealed because of suits filed against State Department of Water Resources. (USGS)
W88-00726

IMPLEMENTING SOCIAL FEASIBILITY IN WATER RESOURCE PLANNING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Virginia Water Resources Research Center.
M. S. Hrezo, and W. J. Howe.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-202172/AS. Price codes: A04 in paper copy, A01 in microfiche. Completion Report, 1984. 71 p, 1 fig, 5 tab, 87 ref. Project No. USGS G874-04.

Descriptors: *Public participation, *Water management, *Public policy, Resources management, Citizen participation, Public hearings, Social participation, Water policy.

The study found a wide gap between the advice on public participation offered by the literature and current state public participation programs. The literature suggests consulting a wide number and variety of citizens and interests, involving participants throughout the planning process, utilizing several different types of involvement techniques, and allowing citizens to help evaluate and select plans. The current pattern of public participation in water resource planning found in a survey of 31 states, on the other hand, emphasizes a limited number of participants, limited types of involvement, and involvement at limited points in the planning process. Six major recommendations are offered to bridge the gap by incorporating greater consideration of social values into water resource planning: (1) Actively solicit and use citizen input; (2) Adopt the functional orientation (provide information to citizens, solicit their reaction to plans, or engage in dialogue with them over goals and alternatives) appropriate to the particular planning stage; (3) Invest resources in a staff member trained in adult education techniques; (4) Develop ongoing and continuous public participation programs; (5) Accord feedback a high priority; and (6) Make sure all participants understand their respective roles and responsibilities. (Hrezo-VA WRRC)
W88-00738

LAND APPLICATION OF MUNICIPAL WASTEWATER: IMPACTS OF WATER RIGHTS AND LAND-USE CONTROLS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-00744

EVALUATION OF HISTORIC CULTURAL RESOURCES IN RELATION TO THE CENTRAL ARIZONA WATER CONTROL STUDY,
Archaeological Research Services, Tempe, AZ.
For primary bibliographic entry see Field 6G.
W88-00791

CITIZENS'S HANDBOOK ON GROUNDWATER PROTECTION,
Natural Resources Defense Council, Inc., New York.
For primary bibliographic entry see Field 5G.
W88-00816

PROTECTING INSTREAM FLOWS IN IDAHO: AN ADMINISTRATIVE CASE STUDY,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
For primary bibliographic entry see Field 4A.
W88-00902

SPECIAL GROUND WATER STUDY: BASIN-WIDE REPORT AND EXECUTIVE SUMMARY.
Delaware River Basin Commission, West Trenton, NJ.
For primary bibliographic entry see Field 4B.
W88-00916

TOXICS MANAGEMENT IN CALIFORNIA.
California Hazardous Substance Task Force, Sacramento, CA.
(1984). 66 p, 5 ref, 4 append.

Descriptors: *Waste disposal, *Waste dumps, *Toxicity, *Administrative regulations, *Operating policies, *Hazardous materials, *Contamination, Legal aspects, Policy making, Administrative agencies, Pathogens, Landfills, Wash water.

Hazardous waste issues in California that require immediate administrative attention are outlined in this report by an interagency task force. No well-researched totals exist for the amount of toxic substances already present or the amount of hazardous waste being produced or disposed of in the state, but estimates have ranged from 10 million to 44 million tons each year. Several state agencies are attempting to provide information on hazardous wastes, but a statewide, coordinated effort is lacking, since no agency has full responsibility to produce a comprehensive report and regulatory requirements are often complex. It is estimated that 65 percent to 85 percent of all hazardous wastes are discharged, either legally or illegally, to sewer systems or surface waters. These wastes are generally high volume, low toxicity wastes, such as rinse waters. Since comprehensive information does not exist, state and local agencies are unable to determine how much waste is being dumped illegally. Recently,the state fee for extremely hazardous waste disposal was raised from $4 per ton to $18 per ton. The increase could cause more illegal dumping. It is reasonable to project that the operators of Class I sites will face increasing pressure to close their sites as the public becomes more adamant about having a Class I landfill in their neighborhood. In addition, a 1980 survey by the Department of Health Services in cooperation with the State Water Resources Board identified 6,000 hazardous waste sites that pose a health threat. (Hawkins-Omniplan)
W88-00919

SPECIAL GROUNDWATER STUDY OF THE UPPER DELAWARE RIVER BASIN, STUDY AREA III, VOLUME I,
Wright (R.E.) Associates, Middletown, PA.
For primary bibliographic entry see Field 2F.
W88-00923

6F. Nonstructural Alternatives

IMPOUNDMENT AND DIVERSION SYSTEMS FOR PREVENTING OR MITIGATING FLOODING,
For primary bibliographic entry see Field 4A.
W88-00503

FLOODS ON VALLEY RIVER, TATHAM CREEK, AND JANALUSKA CREEK IN THE VICINITY OF ANDREWS, NORTH CAROLINA.
For primary bibliographic entry see Field 2E.
W88-00645

LAND APPLICATION OF MUNICIPAL WASTEWATER: IMPACTS OF WATER RIGHTS AND LAND-USE CONTROLS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-00744

GUIDELINES FOR ASSESSING FLOOD DAMAGE IN SOUTH AFRICA,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Social and Economic Research.
For primary bibliographic entry see Field 6C.
W88-00832

6G. Ecologic Impact Of Water Development

EXTERNAL EFFECTS OF IRRIGATORS' PUMPING DECISIONS, HIGH PLAINS AQUIFER,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 4B.
W88-00023

COMPARATIVE STUDY OF WATER LEVEL REGIMES AND LITTORAL BENTHIC COMMUNITIES IN SCOTTISH LOCHS,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 2H.
W88-00113

SOCIAL IMPACTS ON RURAL COMMUNITIES,
A. Schaffer, and R. C. Schaffer.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 309-330, 27 ref.

Descriptors: *Environmental effects, *Water supply, *Social impact, *Agriculture, *Rural sociology, Dry farming, Irrigation, Water scarcity, Economic aspects, Community development, Employment, Unemployment.

The adoption of dryland farming as water supplies decline has profound effects on a local community. Among these effects are dwindling bank credit, closing local businesses, moving assets and population to larger and more prosperous communities, and weakening of leadership. Some of the adaptive measures available to rural communities include efforts to diversify the local economy, strengthen local organizations, and establish intercommunity and regional coalitions to gain assistance from the federal level. (See also W88-00291) (Cassar-PTT)
W88-00305

ENVIRONMENTAL IMPACTS,
B. A. Stewart, and W. Harman.
IN: Water Scarcity: Impacts on Western Agriculture. Univ. of California Press, Berkeley. 1984. p 354-379, 3 fig, 1 tab, 6 ref.

Descriptors: *Environmental effects, *Water supply, *Agriculture, Irrigation, Wildlife, Fish, Recreation, Pesticides, Fertilizers, Land use, Crop yield, Dry farming, Water quality, Water scarcity.

Agricultural activities affect the environment in four general ways: (1) use of chemicals to increase agricultural production, (2) excessive and/or inefficient use of water, (3) injudicious agricultural practices, and (4) conversion of lands to expand cultivated crops. The extent to which the environment will be affected by agriculture in the future will depend on many factors, perhaps the greatest of which will be the degree of pressure placed on soil and water resources to meet demand for food and fiber. Irrigated acreage is expected to expand, but at a much slower rate than in the past. Acreage will decrease in some regions as water supplies diminish. Improved conversation technology may provide some water for alternative uses. However, streamflows in the West are expected to decline. Water quality problems will become more acute, affecting fish, wildlife and recreation. However, better control of fertilizers and pesticides may reduce the amounts of these substances reaching streams and groundwater. Conservation tillage programs improve wildlife habitats. (See also W88-00291) (Cassar-PTT)
W88-00307

SALINITY AND PHOSPHORUS ROUTING THROUGH THE COLORADO RIVER/RESERVOIR SYSTEM,
Bureau of Reclamation, Salt Lake City, UT. Upper Colorado Region.
J. B. Miller, L. Wegner, and D. R. Bruemmer.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 19-41, 11 fig, 21 ref.

Descriptors: *Lakes, *Nutrients, *Reservoirs, *Phosphorus, *Salinity, *Algae, *Environmental effects, Flaming Gorge Dam, Glen Canyon Dam, Lake Powell, Lake Mead, Limnology, Eutrophication, Thermal stratification, Stratification, Cyanophyta, Nutrients, Colorado River.

The construction of storage reservoirs on the Colorado River systems has contributed to significant changes in salinity and phosphorus relationships in the reservoir sequence, Fontenelle, Flaming Gorge, Lake Powell, and Lake Mead. Salinity levels below the dams peaked about 5 years after start of filling, then decreased. In the early years salinity was minimum during the summer months. In the later 1970's salinity levels were nearly uniform throughout the year. Salinity variations at each dam in the series and the relationships among the series of dams are detailed. The four reservoirs in this series, which lie within phosphate-containing basins, retain 70% to 95% of their inflowing phosphorus loads. Most of this phosphorus is bound to sediment and is biologically unavailable. However, chemical reduction and in-reservoir movement release phosphorus in summer, contributing to blue-green algal blooms downstream. Key factors in determining the timing and strength of the blue-green algal bloom and the amount of reservoir which it affects depends on the location and stability of the fall thermocline. (See also W86-02484) (Cassar-PTT)
W88-00340

EFFECTS OF MAINSTREAM DAMS ON PHYSICOCHEMISTRY OF THE GUNNISON RIVER, COLORADO,
Montana Univ., Bigfork. Biological Station.
J. A. Stanford, and J. V. Ward.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 43-56, 7 fig, 2 tab, 8 ref.

Descriptors: *Environmental effects, *Rivers, *Dams, *Reservoirs, *Water quality, Gunnison River, Colorado River, Algae, Dissolved solids, Reservoir releases, Seasonal variation, Temperature, Water temperature, Nitrates, Organic matter.

Reservoir releases on the Gunnison River, a tributary to the Colorado River, have changed the physicochemistry of the river when compared with the pre-regulation era. The main differences are related to a reduction in seasonal variability. Tailwater temperatures are several degrees C warmer in winter and 7-20 degrees C colder in summer than before regulation. Dissolved solids (except nitrate) and particulate organic matter are reduced in concentration within reservoir tailwaters in comparison to concentrations in river segments above the reservoirs. Nitrate levels increase in downstream direction, with higher values in tailwaters compared with sites above the reservoirs. Availability of nitrate and other nutrients has stimulated growth of benthic algae, particularly Cladophora, below the dams. As the distance downstream from the impoundments increases, the changes produced by the presence of the reservoirs gradually reverse so that the physicochemistry of the Gunnison River at its confluence with the Colorado River is similar to pre-regulation conditions except for the decrease in flow variability and an increase in dissolved solids. Processes which can ameliorate the changes include comminution and agglutination of particulate organic matter, heat from the sun, and side streams. (See also W86-02484) (Cassar-PTT)
W88-00341

INFLUENCE OF LAKE POWELL ON THE SUSPENDED SEDIMENT-PHOSPHORUS DYNAMICS OF THE COLORADO RIVER INFLOW TO LAKE MEAD,
Nevada Univ., Las Vegas. Lake Mead Limnological Research Center.
T. D. Evans, and L. J. Paulson.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 57-69, 4 fig, 4 tab, 25 ref.

Descriptors: *Environmental effects, *Lakes, *Rivers, *Reservoirs, *Dams, *Phosphorus, *Sediments, Suspended sediments, Colorado River, Lake Powell, Lake Mead, Water quality.

Construction of Lake Powell, upstream of Lake Mead on the Colorado River, reduced the suspended sediment flowing into Lake Mead by 70-80% from the 140 million tons/year transported before the impoundment. The direct drainage area to Lake Mead was reduced to a few tributaries in the Grand Canyon. The only appreciable sediment source to the Colorado is the Little Colorado River. A linear relationship exists between total phosphorus and suspended sediments. Preliminary data indicate that 10-30% of the total phosphorus is biologically available. (See also W86-02484) (Cassar-PTT)
W88-00342

ANALYSIS OF POTENTIAL SEDIMENT TRANSPORT IMPACTS BELOW THE WINDY GAP RESERVOIR, COLORADO RIVER,
New Mexico State Univ., Las Cruces.
T. J. Ward, and J. Eckhardt.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 91-104, 7 fig, 6 tab, 3 ref.

Descriptors: *Environmental effects, *Sediment transport, *Rivers, *Reservoirs, *Water transfer, Windy Gap Reservoir, Colorado River, Sedimentation, Bed load, Suspended sediments.

Potential downstream aggradation from a river diversion on the Colorado River was studied in the field and with a computer model. It was concluded that no significant aggradation should occur. However, under conditions leading to increased sediment loading (wildfire or flash flooding) temporary aggradation could be a problem. Under present conditions and operating restraints the trout streams should be unaffected. (See also W86-02484) (Cassar-PTT)
W88-00343

HISTORICAL PATTERNS OF PHYTOPLANKTON PRODUCTIVITY IN LAKE MEAD,
Nevada Univ., Las Vegas. Lake Mead Limnological Research Center.
R. T. Prentki, and L. J. Paulson.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 105-123, 6 fig, 5 tab, 25 ref.

Descriptors: *Environmental effects, *Reservoirs, *Dams, *Phytoplankton, Algae, Lake Mead, Lake Powell, Colorado River, Phosphorus, Sedimentation, Lake sediments.

Sediments of Lake Mead, impounded in 1935, were studied to reconstruct a history of phytoplankton productivity. Estimates of whole lake phytoplankton production (in tons C/year x 1000) were 146 before 1954, 651 during 1955-1962, and 144 since 1963, when Lake Powell was impounded. Productivity in the lower basin during the three periods was 0.6, 43, and 73, respectively; in the upper basin, 117, 395, and 44, respectively . The upper basin is severely phosphorus limited whereas the lower basin receives nutrients from the Las Vegas Wash. (See also W86-02484) (Cassar-PTT)
W88-00344

STATUS OF THE COLORADO RIVER ECOSYSTEM IN GRAND CANYON NATIONAL PARK AND GLEN CANYON RECREATIONAL AREA,

Museum of Northern Arizona, Inc., Flagstaff.
S. W. Carothers, and R. R. Johnson.

IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 139-160, 3 tab, 52 ref.

Descriptors: *Environmental effects, *Rivers, *Aquatic life, *Recreation, Glen Canyon, Grand Canyon, Colorado River, Ecosystems, Riparian land, Riparian vegetation, Vegetation, Parks, National parks, Wildlife, Hoover Dam, Fish, Aquatic plants, Invertebrates, Animals, Birds, Fishing, Boating.

The ecological impact of the dams in Glen Canyon and in Grand Canyon on the Colorado River and their recreational use is significant. Exotic species have invaded the upper reaches of the river. These are present and potential threats to native organisms, plant and animal, in the area. Invading saltcedar and Russian thistle, which support fewer riparian birds, have become established in the national parks. Downstream of Glen Canyon and Grand Canyon the ecosystem has changed drastically. Five of the original 8 native fishes are absent, and the community is dominated by exotic species. Algae and invertebrate communities have changed radically. The decrease in flooding has allowed riparian communities to establish along the lower terraces. The high terrace plants are also changing, probably because they are no longer flooded. A thriving riparian animal community (birds, rodents, reptiles, amphibians) has developed in the formerly bare, flood-swept regions. Recreation in the Glen and Grand Canyons has produced erosion at beaches, contamination by human wastes, water quality problems, trampling of vegetation, and litter. Damage is 20-fold less at Glen Canyon, where the users primarily fish, than in the Grand Canyon, where the users are primarily whitewater runners. (See also W86-02484) (Cassar-PTT)
W88-00346

POTENTIAL ECOLOGICAL IMPACTS OF SNOWPACK AUGMENTATION IN THE UINTA MOUNTAINS, UTAH,

Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
K. T. Harper.

IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 211-231, 1 fig, 6 tab, 30 ref.

Descriptors: *Environmental effects, *Artificial precipitation, *Cloud seeding, *Weather modification, *Snow cover, *Vegetation, Runoff, Precipitation, Streamflow, Wildlife, Watersheds, Forest watersheds, Ecological effects, Recreation, Spruce trees, Pine trees, Fir trees, Alpine regions, Mountains, Meadows, Snowpack, Uinta Mountains, Utah.

Results of studies on the impacts of late-lying snow on four ecosystems (lodgepole pine and spruce-fir forests, subalpine meadow and alpine herbland) are reported. An increase of 10% in the average snowpack is estimated to retard snow-free date 0.6-1.8 days in the four ecosystems considered here and to increase runoff from the combined study areas by 13%. Ten percent more snow could not be shown to alter tree growth or reproduction in the forests studied. A 10% increase in snowpack tended to increase above-ground herb growth in ecosystems that normally have light snowpacks (lodgepole forest and alpine herbland) and to decrease herb production in zones of heavy snowpacks (spruce-fir forest and subalpine meadow). All changes in herb layer production were small. A 10% increase in snowpack is estimated to produce an overall increase of 5.5% in herb production since communities with smaller snowpacks are more widespread than those with heavy snowpack in the study area. Impacts on recreation should be slight. (See also W86-02484) (Author's abstract)
W88-00350

ENVIRONMENTAL AND SOCIAL IMPLICATIONS OF CLOUD SEEDING IN THE COLORADO RIVER BASIN,

Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
E. R. Harris.

IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 249-258, 5 ref.

Descriptors: *Environmental effects, *Weather modifications, *Cloud seeding, *Social impact, *Legal aspects, Colorado River, Water policy, Rivers, Water supply, Public opinion, Attitudes, Liability, Regulations.

Public opposition and skepticism of cloud seeding in the Colorado River basin has moderated since 1960 as education and understanding has increased. As the transition from research to operation of the precipitation augmentation program approaches, public interest in resolution of the legal and policy issues increases. Social costs must be addressed first. Compensation claims can be expected for increased snow removal costs, structural damage, livestock losses, loss of use of grazing areas in late autumn and early spring, wildlife protection, and delayed access to mining areas. Rights to the additional water must be defined. Probably the most acceptable solution is to distribute extra water according to existing water rights. Since it is difficult to prove that weather modification causes damage, plaintiffs have not yet won liability suits. As more data is generated, this situation may change. A report from the Weather Modification Advisory Board favors a no-fault liability theory. The public demand for federal regulation of weather modification is likely to increase as a program becomes operational. Opposition to weather modification is affected by several factors: local differences in weather needs, occurrence of drought periods during cloud seeding efforts, lack of scientific consensus about the available technology, and lack of public participation in decision making. (See also W86-02484) (Cassar-PTT)
W88-00352

ECOSYSTEM APPROACH TO ENVIRONMENTAL MANAGEMENT,

Ecosystem Research Inst., Logan, UT.
J. Carter, and V. Lamarra.

IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 261-287, 12 fig, 2 tab, 14 ref.

Descriptors: *Environmental effects, *Water pollution effects, *Oil shale, *Mine wastes, *Water pollution prevention, White River Shale Project, Model studies, Ecological effects, Ecosystems, Algae, Channel morphology, Water quality, Rivers, Sediments, Suspended sediments, Fish, Wildlife, Aquatic life, Organic matter, Monitoring.

The central problem in the preparation of the Detailed Development Plan for the White River Shale Project was the preparation of a long-term environmental management/monitoring program. The program had to satisfy regulations of the various governing agencies and be flexible and economical. The major difficulty encountered was analyzing and interpreting six years of environmental data in a manner which would allow the management of the White River Shale Oil Corporation to make logical and correct decisions about program needs and which would reflect environmental processes occurring in the region of development. This difficulty was overcome by use of conceptual ecosystem as the organizing principle for the analysis. Use of the model has allowed the establishment of statistically valid quantitative relationships and pointed out areas of insufficient data or lack of coordination. The 1981-82 program was designed to complete the important ecosystem relationships which will be used to guide the long-term monitoring program and aid in evaluation of project impacts and mitigation. (See also W86-02484) (Author's abstract)
W88-00353

PROGNOSIS FOR WATER CONSERVATION AND THE DEVELOPMENT OF ENERGY RESOURCES AT THE SALTON SEA - DESTRUCTION OR PRESERVATION OF THIS UNIQUE ECOSYSTEM,

California State Dept. of Fish and Game, Chino. Chino Fisheries Base.
G. F. Black.

IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 363-382, 5 fig, 2 tab, 36 ref.

Descriptors: *Environmental effects, *Water pollution effects, *Lakes, *Water resources development, *Energy, *Water conservation, *Recreation, *Wildlife, *Aquatic life, Salton Sea, California, Saline lakes, Ecosystems, Fish, Hunting, Waterfowl, Birds, Water conservation, Water level fluctuation, Geothermal resources, Diversion, Evaporation, Drainage water, Irrigation, Colorado River.

The fish, wildlife, and recreational values of the Salton Sea, California, are documented and potential impacts of water resources development are discussed. The 932-sq km water body, which collects agricultural drain water, lies in a sink 85 m below sea level and has no outlet. Recreational activities at the rate of 1.5 million recreation days annually include fishing (orangemouth corvina, bairdiella, and sargo being most successful), hunting (waterfowl), boating, camping, nature study (home for endangered, threatened, and rare species), and sightseeing. Present salinity is 38,000 ppm total dissolved solids (varied from 3,000 to 40,000 since 1907), and present surface level elevation is 69 m below sea level (varied from 60 m below sea level to 74 m below sea level). A project to conserve 25% of the annual Colorado River flow to the Salton by canal lining, reservoir regulation, and water reuse would drop the surface elevation to 74 m below sea level (year 2012) and increase salinity to 101,000 ppm total dissolved solids by 2007 and 96,000 ppm total dissolved solids by 2012. Without these conservation measures the surface elevation and salinity in 2012 are predicted to be 70 m below sea level and 59,000 ppm total dissolved solids. If geothermal resources are developed, the Sea will shrink to half its present size, and salinity levels will increase greatly. High salinities and smaller area would severely affect the fish and bird populations, the pileworm (an invertebrate fish food), and boating. Possible solutions to these environmental problems include evaporation and collection of salt, diversion of excess river water, and reinjection of geothermal water. (See also W86-02484) (Cassar-PTT)
W88-00355

EFFECTS OF IMPROVEMENTS ON SALINITY IN THE COLORADO RIVER,

Nevada Univ., Las Vegas.
L. J. Paulson, and J. R. Baker.

IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 457-474, 2 fig, 3 tab, 27 ref.

Descriptors: *Environmental effects, *Water quality control, *Reservoirs, *Rivers, *Dissolved solids, *Salinity, Gypsum, Calcium, Halite, Sodium, Chlorides, Sulfates, Colorado River, Lake Mead, Lake Powell, Carbonates, Calcite, Phytoplankton, Chemical precipitation.

Comparison of pre- and post-impoundment ion and total dissolved solids budgets for Lake Mead and Lake Powell showed that concentrations of certain ions were drastically changed by the impoundments. In Lake Mead sulfate concentrations were higher than expected; silica, calcium, and carbonate concentrations were lower than expected. The sulfate levels were a result of dissolution of gypsum. Halite dissolution also raised sodium and chloride levels slightly. Calcite precipitation reduced calcium and carbonate levels. However, rates of gypsum and halite dissolution decreased over the years as freshly exposed outcroppings became leached or covered with silt. Results of this study showed that although salinity control of point sources is beneficial, it may not be cost-effective since gypsum does not adversely affect agriculture. Reduction of calcium and carbonate levels by the impoundments has saved about $240,500 in hard water damages to water systems. Sodium and chloride concentrations should be controlled, preferably at point sources, rather than attempt to control total dissolved solids. (See also W86-02484) (Cassar-PTT)
W88-00360

EFFECT OF HABITAT ALTERATION BY ENERGY RESOURCE DEVELOPMENTS IN THE UPPER COLORADO RIVER BASIN ON ENDANGERED FISHES,
Fish and Wildlife Service, Salt Lake City, UT.
For primary bibliographic entry see Field 8I.
W88-00364

EFFECTS OF WATER LEVEL FLUCTUATIONS ON THE SPAWNING SUCCESS OF LARGEMOUTH BASS (MICROPTERUS SALMOIDES) IN LAKE MEAD,
Arizona Game and Fish Dept., Kingman. Region III Office.
S. A. Morgensen.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 563-578, 5 fig, 3 tab, 29 ref.

Descriptors: *Ecological effects, *Fish, *Reservoir operation, *Water level fluctuations, Bass, Largemouth bass, Spawning, Lake Mead, Wave action, Wind.

Water level fluctuations and bass nesting in Lake Mead were studied during 1978-81. During this period the water level varied from 360.5 to 367.5 meters. Peak water levels generally occurred at the beginning of the nesting season in February-March. Nesting success varied greatly among stations but not among years. Annual success rates were 55.4% in 1978; 57.5%, 58.0%, and 51.7% in successive years. The most commonly observed cause of nest failure was physical destruction from wind and wave action. A deviation of 2 C above or below the mean of 17.7 C also disrupted nesting activity. No correlation was evident between depth of nest (30 to 457 cm at construction) and rate of water level change. Duration of nest varied with temperature from 4 to 19 days, average 11.5 days at 17.7 C. Survival of young bass was better in 1980, when water levels increased 152.4 cm during the summer months. Conclusions are that water level declines of 0.88-3.94 cm/day as experienced during the springs of 1978-81 had little effect on bass nesting. However, rates greater than 6 cm/day would expose more than 85% of the nests to wing and wave destruction. (See also W86-02484) (Cassar-PTT)
W88-00366

RECORD OF DECISION FOR THE RESOURCE MANAGEMENT PLAN/FINAL ENVIRONMENTAL IMPACT STATEMENT.
Bureau of Land Management, Casper, WY.
BLM-WY-PT-84-008-4410, July 1985. 93 p, 14 maps, 6 tab, 9 ref.

Descriptors: *Management planning, *Planning, *Resources management, Water management, Resources development, Water resources development, Platte River, Land development, Land management, Land resources, Land reclamation, Natural resources.

The resources management plan described here includes land-use considerations focusing on cultural resources, energy, minerals, fire, forest, grazing, lands, recreation, soil, water, air, and wildlife. 'Prescriptions' are presented for a variety of resource management 'units', including both terrestrial and aquatic habitats. Aquatic resources include the Pine Mountain-Goldeneye Reservoir and the North Platte River, both in Wyoming. The dominant resource values at Pine Mountain-Goldeneye Reservoir are wildlife, with critical habitat for a rare and endangered species (bald eagle roosting, perching, and feeding areas) on Pine Mountain, and waterfowl and fisheries populations at Goldeneye Reservoir. Management at the North PLatte River area will focus on bald eagle habitat and seven canoe trail sites. (Halterman-PTT)
W88-00474

AQUATIC ECOLOGICAL ASSESSMENTS: REGIONAL DATA SOURCES AND THEIR APPLICATION,
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 6B.
W88-00483

UTILIZATION OF OHIO RIVER SHALLOW WATER HABITATS BY YOUNG-OF-THE-YEAR FISHES,
Ohio State Univ., Columbus. Museum of Zoology.
G. R. Carter, and T. M. Cavender.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-207148/AS. Price codes: A06 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus, Completion Report, 1984. 104 p, 10 fig, 33 tab, 95 ref. Project No. OWRT A-064-OHIO(1).

Descriptors: *Ohio River, *Juvenile fishes, *Flood pool habitats, Fish communities, Trophic structure, Growth rate, Navigation dams, Ohio.

Between 9 June and 11 November, 1981 and 9 June and 8 October, 1982, 149 samples were collected from selected backwater and mainstem sites of the middle Ohio River (between river mile 339 and 424). Sites were collected at approximately triweekly intervals during 1981 and bi-weekly intervals in 1982 using a 10m x 2m bag seine with 2m x 2m bag, 5.5 ace mesh wings and 2mm ace mesh bag. Analysis of young-of-the-year fishes collected indicates that backwaters are more important than mainstream margins in terms of the number of species supported, relative frequencies and comparative densities. Total number of species collected from backwaters was 54 and from mainstem margins was 42. Twenty-one species were collected in 60 percent or more of the backwater samples compared to 6 species collected in 60 percent of samples for mainstem margins. Comparative densities as analyzed by the T-test were significantly higher (at the 0.5 level) for a greater number of species in backwaters (16) than in mainstem (0). In terms of relative abundance, emerald shiners (Notropis atherinoides) dominated mainstem margins (96 percent of total numbers collected). Dietary habits of the 14 most abundant young-of-the-year species from 1982 were examined over three dates (21 July, 26 August and 7 October). A total of 26 items were found to be consumed by the above species. Analysis of diet-overlap was performed using the Schoener Index. (USGS)
W88-00537

HABITAT SUITABILITY INDEX MODELS: GREEN SUNFISH,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
R. J. Stuber, G. Gebhart, and O. E. Maughan.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-148205. Price codes: A03 in paper copy, A01 in microfiche. Report FWS/OBS-82/10.15, July 1982. 28 p, 2 fig, 3 tab, 67 ref.

Descriptors: *Habitats, *Aquatic habitats, Green Sunfish, Model studies, Environment, Aquatic environment, Aquatic ecosystems, Water quality.

To aid in impact assessment and habitat management activities, habitat-use information and Habitat Suitability Index (HSI) models are presented for the green sunfish. Literature concerning a species' habitat requirements and preferences is reviewed and synthesized into HSI models, which are scaled to produce an index between 0, which represents unsuitable habitat, and 1, which represents optimal habitat. Assumptions used to transform habitat base information into these mathematical models are noted, and guidelines for model application are described. Other models cited in the literature which can also be used to calculate an HSI are sited, and simplified HSI models, based on what the authors believe to be the most important characteristics for this species, are presented. Habitat variables include percent of bottom cover, percent pools, dissolved oxygen, turbidity, pH, temperature, salinity, substrate type, current velocity, stream gradient, and stream width. The models presented include those for riverine and lacustrine habitats. (Halterman-PTT)
W88-00640

GUIDANCE MANUAL FOR THE INPUT OF BIOLOGICAL INFORMATION TO WATER-INTAKE-STRUCTURE DESIGN,
Battelle Pacific Northwest Labs., Richland, WA.
D. A. Neitzel, M. A. Simmons, and D. H. McKenzie.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-020953. Price codes: A03 in paper copy, A01 in microfiche. PNL--4133/UC-97e, December 1981. 37 p, 12 fig, 7 tab, 17 ref. Contract No. 14-16-0009-79-1401.

Descriptors: *Intake structures, *Entrainment, *Impingement, *Environmental protection, Intake gates, Fish, Shellfish, Ecological effects, Environmental effects, Environmental engineering.

The procedures for providing a design engineer with biological information that can reduce the impact of water intake structures on aquatic resources are outlined. The first facet of this process is the characterization of fish and shellfish, the intake stimuli (temperature change, current change, noise, new habitat) and the response of the organisms to the stimuli. The second facet of the process involves the quantification of the stimulus/response relationship. The third facet of this process is described as experimentation and data analysis. This phase helps to define specific tasks or experiments that can be used to generate data for quantifying stimulus/response relationships. (Halterman-PTT)
W88-00643

ENVIRONMENTAL ASSESSMENT: L-REACTOR OPERATION, SAVANNAH RIVER PLANT, AIKEN, S.C.
Department of Energy, Aiken, SC. Savannah River Operations Office.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-020304. Price codes: A10 in paper copy, A01 in microfiche. DOE/EA-0195. Report DOE/EA-0195, August 1982. 153 p, 21 fig, 43 tab, 115 ref, 3 append.

Descriptors: *Radioactive wastes, *South Carolina, *Environmental effects, *Public health, Cesium radioisotopes, Water resources development, Thermal stress, Water pollution effects, Air pollution, Water quality, Environmental impact statement, Nuclear reactors, Nuclear energy, Rivers, Ecological effects, Entrainment, Savannah River Plant, Aiken.

The potential environmental impacts of the proposed resumption of L-Reactor operation, which is brought out of standby status to meet nuclear materials production needs, are evaluated in terms of the expected differences between pre-1968 and post-1984 operation. Of the nonradiological impacts examined, the ones expected to show negligible differences between pre-1968 and post-1984

operation of the L-Reactor are land use and socioeconomics, archeological sites, cooling-water system (water withdrawal and fish entrainment), endangered species, and thermal discharge to Steel Creek and the Savannah River. Expected differences in water quality are no discharge to the basin in the L-Reactor area and improved sanitary waste treatment. Expected differences in air quality are lower post-1984 emission levels due to increased efficiency of the K-Area boiler and the installation of particulate control devices for coal-fired boilers. Post 1984 impacts for solid wastes would be lower due to improved disposal procedures and use of the K-Area boiler. Of the radiological impacts examined, the operating personnel exposures and risks to the public are expected to be lower in post-1984 operations. The probability of accidents during post-1984 operations has been reduced by incorporation of safety system improvements in the L-Reactor. The post-1984 impact of the transport of radiocesium will be less than pre-1968 impacts. (Geiger-PTT)
W88-00644

MISSISSIPPI RIVER NAVIGATION SYSTEM: ENVIRONMENTAL EVALUATIONS OF PROPOSED MOORING FACILITIES,
Versar, Inc., Springfield, VA.
P. R. Abell, C. W. Burch, R. L. Dawson, C. F. Dilks, and P. L. Gilmore.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-124701. Price codes: A05 in paper copy, A01 in microfiche. Final Report, March 1982. 96 p, 1 fig, 1 tab, 54 ref. Contract No. DACW43-80-D-0025.

Descriptors: *Buoys, *Docks, *Piles, *Environmental effects, *Ecological effects, Water quality, Anchors, Navigation, Navigable rivers, Piers, Evaluations, Aquatic plants, Aquatic animals, Environmental impact statement.

As part of the Mississippi River Mooring System, an investigation was undertaken to evaluate the generic environmental implications of various mooring devices and structures. The study area encompassed the Mississippi River Navigation System. In general, regulated mooring devices are preferred over unregulated devices. The use of piling, mooring cells and buoys is generally more environmentally compatible than deadmen, fleeting barges, and anchor barges. Wooden pilings have few significant impacts except during installation, when pile driving noise may have adverse effects on residential areas, spawning grounds, and avian nesting areas. Steel pilings, wooden dolphins, and steel dolphins are similar to wooden pilings in environmental impacts. Mooring cells have similar impacts, though they also can affect erosion, sedimentation, bottom scour, and aesthetics to a greater degree than wooden pilings. The impacts associated with buoys are dependent upon how the buoy is anchored. The use of buoys with exploding anchors or deadmen anchors can have moderate to significant adverse impacts upon several parameters relating to fauna. Fleeting barges and anchor barges are similar in impacts, and have the potential to adversely affect water quality, rooted aquatic plants, avian nesting areas, and aesthetics. Shoreline deadmen have the potential to impact primarily terrestrial subparameters such as shore erosion, trees, groundcover, and avian nesting areas. (Geiger-PTT)
W88-00648

PROTOTYPE EVALUATION OF SELECTED NEPA PREDICTED ENVIRONMENTAL IMPACTS FOR CONSTRUCTION GRANTS PROJECTS.
ESEI/EcolSciences, South Bend, IN.
Environmental Protection Agency, Chicago, IL. March 1985. 297 p, 12 fig, 9 tab, 4 append. Contract No. 68-04-5017.

Descriptors: *Regulations, *Legal aspects, *Environmental impact statements, Wetlands, Land use, Aquatic habitats, Environmental effects, Environmental policy.

The promulgation of the National Environmental Policy Act (NEPA) in 1969 established a process by which federal agencies were required to assess the environmental impacts of their actions. With the passage of the Federal Water Pollution Control Act, a detailed facilities planning process was defined as part of the Construction Grants program. The Agency's environmental review responsibilities of individual facilities plans are defined in the Implementation of Procedures on the National Environmental Policy Act. A methodology was developed for evaluating the accuracy of NEPA-predicted environmental impacts. This methodology is presented in EPA's Manual for Evaluating Predicted and Actual Impacts of Construction Grants Projects. This report, intended as a companion document to that manual, presents four examples (prototypes) of its use which illustrate its versatility, strengths and weaknesses. The examples employed in the prototypes pertain to impacts on wetlands and flood plains, population predictions and land plans. The evaluation of two completed NEPA documents are also presented. (Halterman-PTT)
W88-00678

TECHNICAL AND ECONOMIC IMPACT OD RESERVOIR SEDIMENTATION,
Electricite de France, Beziers.
For primary bibliographic entry see Field 2J.
W88-00695

PHYSICAL PROCESSES OF RESERVOIR SEDIMENTATION,
Dundee Univ. (Scotland).
For primary bibliographic entry see Field 2J.
W88-00696

APPLICATION OF STREAMFLOW TRANSPORT MODELS TO THE YAKIMA RIVER, WASHINGTON,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
D. K. Mueller, and R. L. George.
Available from the National Technical Information Service, Springfield, VA 22161, PB85-172625. Price codes: A03 in paper copy, A01 in microfiche. Report REC-ERC-84-13, August 1984. 38 p, 21 fig, 19 tab, 17 ref.

Descriptors: *Water quality, *Hydrologic models, *Water resources development, *Environmental impact statements, *Streamflow, Models, Model studies, Comparison studies, Simulation analysis, Water temperature, Dissolved oxygen, Nitrates, Biochemical oxygen demand, Ammonia, Phosphates, Chlorophyll, River basins, Environmental effects.

Water resource development projects must be studied with respect to their impacts on water quality. To this end, two popular streamflow transport simulation models, QUAL-II and WQRRS, were calibrated and verified using data on the Yakima River Basin in south-central Washington. Data were collected in four synoptic surveys during low-flow periods between August 1981 and November 1982. Both models gave similar results compared to observed target parameters values. Simulation of temperature, dissolved oxygen, and nitrate was reasonably accurate. Results for biochemical oxygen demand, ammonia, orthophosphate, and chlorophyll a were not as good, to some extent due to inadequacies in the data set. The validated models and calibrated data sets are available for use in evaluating water quality impacts of water resources development in the Yakima Basin. On the basis of ease of application use of QUAL-II is recommended. (Author's abstract)
W88-00782

COLUMBIA BASIN WILDLIFE/IRRIGATION DEVELOPMENT STUDY,
Washington State Dept. of Game, Ephrata.
J. H. Foster, W. E. Tillett, W. L. Myers, and J. C. Hoag.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-183952. Price codes: A11 in paper copy, A01 in microfiche. Bureau of Reclamation, Denver, CO., Engineering and Research Center. Report No. REC-ERC-83-6, December 1984. 245 p, 54 fig, 83 tab, 111 ref, 8 append.

Descriptors: *Environmental effects, *Irrigation, *Wildlife, *Waterfowl, Predation, Habitats, Aquatic habitats, Marshes, Lakes, Ponds, Streams, Canals, Waterways, Fish, Fisheries, Zooplankton, Phytoplankton, Invertebrates, Benthos, Water quality, Herbicides, Aquatic weed control, Columbia River, Washington, Columbia Basin Irrigation Project, Nesting, Ecology, Birds, Water resources development, Land use, Aquatic plants, Agriculture.

This report describes investigations conducted in the Columbia Basin, Washington, to determine the effects of irrigated farming and irrigation project operation on fish and wildlife resources. Field investigations focused on ring-necked pheasants, Canada goose, mallard, redhead, rainbow trout, and yellow perch, although other species are also discussed. Populations, nesting densities, habitat use, cover requirements, and effects of predation and human disturbance on pheasants during four seasons are discussed for six land use types. Seasonal populations, movements, and habitat use of waterfowl are related to three major wetland types. Data analysis also covered waterfowl nesting densities and brood production in relation to common carp, cattle grazing, human disturbance, and several wetland morphological characteristics. The study examines relationships between upland birds and waterfowl and agricultural crops, farming practices, operation and maintenance of irrigation canals and facilities, weather, and wildlife refuge areas. Lakes and streams are classified in Columbia Basin Project Area in relation to connection with irrigation water distribution systems. Physico-chemical features and invertebrate life of aquatic habitats are compared with fish populations, growth and condition factors. Recommendations are presented for maintaining or improving fish and wildlife in irrigated agricultural environments. Conclusions and recommendations, while developed for irrigation projects in central Washington, will be useful to water development agencies and wildlife managers everywhere. (Author's abstract)
W88-00784

GARRISON DIVISION UNIT COMMISSION, SUPPLEMENT TO INTERIM STAFF REPORT ON ISSUES AND ALTERNATIVES.
Garrison Diversion Unit Commission, Bismarck, ND.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-154938. Price codes: A04 in paper copy, A01 in microfiche. November 28, 1984. 55 p, 6 fig, 5 append.

Descriptors: *Planning, *Environmental effects, *Water resources development, *Diversion, Water transfer, Garrison Diversion, North Dakota, Irrigation, Cost-benefit analysis, Water use, Wildlife, Wetlands, Water quality, Reservoirs, Lonetree Reservoir, James River, Tsayer Reservoir, Devils Lake, Water rights, Economic aspects, Public participation, Fish, Aquatic life, Missouri River, Sheyenne River, Canada.

This report supplements a report on issues and alternatives concerning the Garrison Diversion, North Dakota. After a public hearing on 25 alternatives, three were chosen for further consideration. Details on these three alternatives are given. Alternative 1, the 250,000-acre authorized Garrison Diversion Unit (1965), diverts Missouri River water to the James River Basin, Devils Lake closed basin, and Hudson Bay drainage, principally for irrigation use. Alternative 2, the 165,000-acre state of North Dakota plan, postpones the Souris Loop irrigation and includes the 165,000 acres of irrigated land either entirely within the Missouri/James watershed or has no return flows to the Hudson Bay watershed. A 100-cfs outlet for municipal and industrial use conveys water from the Lonetree Reservoir to the Sheyenne River and to Devils Lake. Alternative 3, a composite of 4 of more of the original 25 alternatives, has 7 variations. Basically, alternative 3 provides irrigation to about 246,000 acres of land and prevents return

flows from entering the Hudson Bay watershed. The distribution system provides municipal and industrial service for 450,000 persons in 162 towns and rural areas, using Missouri River water and some locally available groundwater supplies. (Cassar-PTT)
W88-00785

EVALUATION OF HISTORIC CULTURAL RESOURCES IN RELATION TO THE CENTRAL ARIZONA WATER CONTROL STUDY,
Archaeological Research Services, Tempe, AZ.
L. M. Stone, and J. E. Ayres.
July 1984. 108 p, 7 fig, 9 tab, 9 ref.

Descriptors: *Dams, *Arizona, *Archaeology, Damsites, Central Arizona Water Control Study, History.

Following extensive flooding along the Salt, Gila, Verde and Agua Fria Rivers in 1978 and 1980, the Central Arizona Project and the Central Arizona Water Control Study (CAWCS) were established. The objectives of the CAWCS were to identify and evaluate alternative measures for flood control and regulatory water storage in Central Arizona in conjunction with construction of the Central Arizona Project. This report provides a synthesis of the CAWCS from the perspective of historic sites cultural resources and presents data on historic sites, including those at the New Waddell Dam and Reservoir, Cliff Dam and Reservoir, and the modified Roosevelt Dam. Furthermore, sites at the Buttes Dam and Reservoir and the Confluence Dam are described for the first time. This report describes the data gathering process and presents data on 247 sites, 228 of which were considered to be of potential National Register of Historic Places quality. Also presented is National Historic Preservation Act compliance documentation, including National Register eligibility determination documentation. A proposal for the preservation of those areas which will be adversely affected by the project is also outlined. (Halterman-PTT)
W88-00791

GARRISON DIVERSION UNIT COMMISSION, PRELIMINARY FINAL REPORT.
Garrison Diversion Unit Commission, Bismarck, ND.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-154946. Price codes: A06 in paper copy, A01 in microfiche.
December 5, 1984. 95 p, 2 fig, 5 tab, 5 append.

Descriptors: *Planning, *Environmental effects, *Water resources development, *Diversion, *Garrison Diversion, *North Dakota, Water transfer, Irrigation, Cost-benefit analysis, Water use, Wildlife, Wetlands, Water quality, Reservoirs, Lonetree Reservoir, James River, Taayer Reservoir, Devils Lake, Water rights, Economic aspects, Fish, Aquatic life, Sheyenne River, Lake Audubon, McClusky Canal, Snake Creek, Canada.

An alternative to the presently authorized Garrison Diversion was developed from public hearings and citizens' inputs. Many features of the authorized project have been incorporated in whole or in part. Several have already been constructed: Snake Creek pumping plant, Lake Audubon, and the McClusky Canal. Additional features include canals, groundwater recharge facilities, pumping facilities, pipelines and treatment plants for municipal supply, and recreation and fish/wildlife features. Irrigation service would be extended to 108,125 acres and municipal/industrial service to 130 communities. Water delivered into the Hudson Bay watershed would be treated to prevent introduction of objectional fish species or pathogens into Canadian waters. Kraft Slough, a natural resource with considerable wildlife and waterfowl value, would be left in its natural state. Since Lonetree Reservoir is not immediately required, its construction would be delayed until needed. Meanwhile, it can be used as a wildlife refuge. Water quality would be strictly monitored in all irrigated areas, and the Lake Audubon/McClusky Canal system would be freshened to a salinity of <600 ppm. (Cassar-PTT)
W88-00795

ARCHEOLOGICAL INVESTIGATIONS AT PARAJE (DE FRA CRISTOBAL) LA1124: INTERIM REPORT,
Bureau of Reclamation, Amarillo, TX. Southwest Region.
D. K. Boyd.
December 1984. 60 p, 26 fig, 60 ref, 3 append.

Descriptors: *Environmental effects, *Archeology, *Water resources development, Paraje, New Mexico, Elephant Butte Reservoir, Rio Grande Project, Reservoirs.

The historic site at Paraje, New Mexico, lies on Federal land within the Elephant Butte Reservoir, Rio Grande Project, boundary and is on land controlled by the U.S. Bureau of Reclamation. As part of Reclamation's southwest Region's cultural resource management program, historical research and limited archeological testing of the site of Paraje (LA 1124) were undertaken as a means of determining the significance of the site. This is an interim report on Reclamation's investigations of Paraje (de Fra Cristobal), pending completion of the final analysis of archeological materials from the site. In view of the extent and condition of the remains of the historic townsite of Paraje, New Mexico, the site will be nominated to the National Register of Historic Places. (Author's abstract)
W88-00804

INTERIM STAFF REPORT ON ISSUES AND ALTERNATIVES.
Garrison Diversion Unit Commission, Bismarck, ND.
November 7, 1984. 150 p, 24 fig, 4 tab, 35 ref, 6 app, + errata.

Descriptors: *Planning, *Environmental effects, *Garrison Diversion unit, *Water resources development, *Diversion, *North Dakota, Water transfer, Garrison Diversion, Irrigation, Cost-benefit analysis, Water use, Wildlife, Wetlands, Water quality, Reservoirs, Lonetree Reservoir, James River, Taayer Reservoir, Devils Lake, Water rights, Economic aspects, Public participation, Fish, Aquatic life, Missouri River, Sheyenne River, Canada.

The Garrison Diversion Unit Commission was appointed to review the controversy surrounding the authorized Initial Stage of the Garrison Diversion Unit, to evaluate the contemporary water needs of North Dakota, and to make recommendations. This report provides a basis for interested parties to review and comment prior to public hearings. Twenty-five alternatives have been designated for further study. These alternatives are described in detail, and other alternatives are summarized. For each alternative the following are given: description, service benefits and project data, irrigation interest subsidy, land required, water requirements, planning and construction time, benefits and costs, economic indicators, capital cost recovery, and impacts. Areas of concern include irrigation, water needs (municipal, rural, and industrial), biota transfer, wildlife and wetlands mitigation and enhancement, water quality, Lonetree Reservoir, James River conveyance and storage, Devils Lake management, and Indian resources. (Cassar-PTT)
W88-00812

REVEGETATION FOR WILDLIFE ENHANCEMENT ALONG THE LOWER COLORADO RIVER,
Arizona State Univ., Tempe. Center for Environmental Studies.
B. W. Anderson, and R. D. Ohmart.
Bureau of Reclamation, Boulder City, NV. Final Report, December 1982. 215 p, 39 fig, 48 tab, 23 ref, 2 app. Contract No. 7-07-30-V0009.

Descriptors: *Environmental effects, *Vegetation establishment, *Wildlife, *Colorado River, Revegetation, Riparian vegetation, Spoil banks, Dredging, Trees, Birds, Habitats, Reptiles, Mammals, Economic aspects, Irrigation, Cottonwood trees, Salt cedar trees, Shrubs, Willow trees, Honey mesquite trees, Mistletoe, Palo verde trees.

Preliminary results of a revegetation study on two sites along the lower Colorado River are presented. Work was done on a 30-ha dredge-spoil area, devoid of vegetation, and a 20-ha site cleared of the existing salt cedar and other scattered vegetation. Although many questions remained unanswered, some useful information was obtained. Salt cedar has little value to wildlife and has high evapotranspiration rates. This exotic species can be replaced with native vegetation. Growth of native vegetation and planted trees is enhanced by choosing sandy, unlayered soil. Deep tillage or augering a hole through the soil to the water table are essential. Less sandy areas are best for shrubs. Cottonwood and willow trees grow faster than other native trees and are of major importance to wildlife, particularly insect-eating birds. Honey mesquite trees and mistletoe, which parasitizes them, are both important food sources to insects, birds , rodents, foxes, and coyotes. Palo verde trees produce seed pods and nesting sites for some bird species within 2 or 3 years; homes for cavity-nesting birds can be provided by leaving dead trees while clearing vegetation. (Cassar-PTT)
W88-00820

ENVIRONMENTAL FEATURES FOR FLOOD-CONTROL CHANNELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
F. D. Shields.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-120544. Price codes: A07 in paper copy, A01 in microfiche.
Technical Report E-82-7, July 1982. Final Report. 133p, 30 fig, 135 ref, append.

Descriptors: *Environmental effects, *Channel improvement, *Aquatic habitats, *Literature reviews, Aesthetics, Fish habitats, Habitats, Flood control, Wetlands, Vegetation, Recreation, Urban areas.

The environmental effects of channel modification for flood control projects were investigated in a literature review. In general, channel modification produces shorter, smoother, more uniform channels with larger cross-sectional area and less natural vegetation. Overbank flooding is eliminated or reduced. Channel straightening should be minimized. The cross section should be designed for both high and low flows, retaining the existing velocity-vs.-discharge relationship at low flow so that sediment transport is maintained. Adverse environmental impacts are reduced by following the existing channel alignment and by excavating from one side only. Low-flow channels may be constructed within a larger channel, or the existing channel may be preserved as a low-flow channel. Pools, riffles, and water control structures may be constructed to provide suitable aquatic habitats. Meander loops may be maintained as ponds or wetlands. Vegetation preservation or revegetation are important for minimizing adverse environmental effects. Fish habitats can be recovered by armoring the channel with coarse bed material and boulders and by constructing low-flow channels, fishways, pools, and spawning channels. In urban areas stream modifications usually creates opportunities for recreation and beautification. (Cassar-PTT)
W88-00845

INCORPORATION OF ENVIRONMENTAL FEATURES IN FLOOD CONTROL CHANNEL PROJECTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
N. R. Nunnally, and F. D. Shields.
Technical Report E-85-3, May 1985. Final Report. 277 p, 74 fig, 20 tab, 322 ref, 6 append.

Descriptors: *Environmental effects, *Flood control, *Channel improvements, Hydraulic engineering, Water quality, Environmental Engineering, Aquatic habitats, Habitats, Wildlife, Wetlands, Fish, Invertebrates, Rivers, Streams, Alluvial channels, Low flow, High flow, Floodways, Erosion control, Bank stabilization, Linings, Canal linings, Sedimentation basins, Water quality control, Water level, Aesthetics, Recreation, Vegetation.

Information on flood control channel projects has been compiled in a summary report. Channels modified for flood control often experience severe environmental degradation due to erosion and sedimentation, loss of vegetative cover, reduction in amount and value of habitat, and decline in aesthetic value. Many environmental problems result from a failure to recognize the nature of the fluvial system and its interactions with the biological system. Many negative environmental impacts can be avoided by designing flood channels that are in harmony with other fluvial components, minimizing disruptions to existing fluvial and biological systems, and incorporating environmental features into flood channel design. Environmental features are defined as any structures or actions employed in the planning, design, construction, or maintenance of flood control channels that produce environmental benefits. Environmental features may include modifications of standard techniques, such as selective clearing and snagging or single bank construction; modified channel designs, such as low flow channels, pools and riffles, and meandering alignments; structures for erosion and sediment control, water level management, and instream habitat; inclusion of recreational features in project design; and special designs and treatment for aesthetic purposes. Procedures are presented for the design of environmental features. These procedures are based largely on prior experience with the use of environmental features on modified channels and on fluvial processes and natural stream geometry. Tables are provided to help select the best environmental features based on environmental objectives and stream and watershed conditions. (Author's abstract)
W88-00848

MANUAL FOR EVALUATING PREDICTED AND ACTUAL IMPACTS OF CONSTRUCTION GRANTS PROJECTS.
ESEI/EcolSciences, South Bend, IN.
Environmental Protection Agency, Chicago, IL.
January 1985. 95 p, 1 fig, 1 tab, 15 ref, 4 append.
Contract No. 68-04-5017.

Descriptors: *Regulations, *Legal aspects, Land use, Aquatic habitats, Environmental effects, Environmental impact statements, Environmental policy.

The promulgation of the National Environmental Policy Act in 1969 established a process by which federal agencies were required to assess the environmental impacts of their actions. With the passage of the Federal Water Pollution Control Act, a detailed process for assessment was defined as part of the Construction Grants program. As an oversight agency responsible for NEPA decisions, EPA must periodically determine the effectiveness of the Construction Grants program and NEPA in restoring the quality of the nation's waters and in protecting the environment. The primary purpose of this manual is to present an objective methodology for evaluating the accuracy of predicted environmental effects resulting from Construction Grants projects. Issues concerning water quality, wetlands, flood plains, biota, socioeconomics, agriculture, physical environments, cultural resources, solid wastes, energy, and air quality are covered in this manual. A methodology was designed such that the accuracy of impacts predicted for a single project, group of projects, or an entire program can be evaluated. A major result of the evaluation process presented in this manual will be to propose changes to the existing environmental review process to increase the effectiveness and responsiveness to environmental issues. By fulfillment of this objective, it is intended that EPA will increase the effectiveness of the NEPA process, throughout the nation, through the coming decade. (Halterman-PTT)
W88-00868

8-INCH LENGTH LIMIT IN SMALLMOUTH BASS: EFFECTS ON THE SPORT FISHERIES AND POPULATIONS ON SMALLMOUTH BASS AND YELLOW PERCH IN NEBISH LAKE, WISCONSIN,
Wisconsin Dept. of Natural Resources, Madison.
S. L. Serns.
Technical Bulletin No. 148, 1984. 24 p, 2 fig, 24 tab, 22 ref.

Descriptors: *Fish management, *Lake fisheries, *Sport fishing, *Perch, *Bass, Fisheries, Fish harvest, Fishing, Fish populations, Population dynamics, Resources management.

The effects of an 8-inch minimum length limit on smallmouth bass in Nebish Lake, Wisconsin was studied for a 5-yr period (1977-81) and contrasted to the previous 5-yr period (1972-76) when there was no minimum length limit. Population characteristics of smallmouth bass and yellow perch were compared for the 4-yr periods of 1974-77 (pre-length limit) vs. 1978-81 (post-length limit). After the 8-inch length limit on smallmouth bass in Nebish Lake was imposed the mean annual density and biomass of age III+ smallmouth bass was 77% and 79% higher, respectively. The production of fingerling smallmouth bass was 21% lower. Adult annual smallmouth bass was 21% lower. Adult smallmouth bass total annual mortality rates were slightly higher, while smallmouth bass growth increased slightly. Production of age III and IV smallmouth bass nearly doubled. The mean annual density and biomass of adult yellow perch decreased substantially while growth increased. The trade-off of 8% fewer bass in the creel was more than offset by the 30% increase in yield and the 1.2-inch increase in average length of bass creeled. An equilibrium yield model predicted that by increasing the entry level into the sport fishery from age II to age IV, yield would increase 5% and the harvest would decrease by 45%. The Wisconsin Department of natural Resources set the length limit at 10 inches on January 1, 1982 and will monitor the fishery and populations of smallmouth bass and yellow perch through 1986. (Geiger-PTT)
W88-00874

DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN WISCONSIN: II. BLACK, TREMPEALEAU, AND BUFFALO RIVER BASINS,
Wisconsin Dept. of Natural Resources, Madison.
D. Fago.
Technical Bulletin No. 140, 1983, 120 p, 4 fig, 17 tab, 20 ref, 2 append.

Descriptors: *Fisheries, *Fish populations, *Fish management, *Surveys, *Wisconsin, Baseline studies, Fish, Environmental impact statement, Ecosystems, Water resources development, River basin development, Black River basin, Trempealeau River basin, Buffalo River basin.

A statewide survey of the inland waters of Wisconsin was initiated in 1974 by the Bureau of Research, Wisconsin Department of Natural Resources, to establish a comprehensive data base on the distribution and relative abundance of all fish species. The Black and Trempealeau river basins were sampled from 1975 through 1979 and the Buffalo River basin from 1975 through 1982 at 638 stations. An additional 151 stations were partially sampled. A total of 97 species were collected from the Black River basin, 79 from the Trempealeau River basin, and 60 from the Buffalo River basin. The endangered starhead topminnow, the threatened speckeled chub, blue sucker, and gilt darter were included. Eight species on the Department's watch list were also collected. Data from recent collections for the Black, Trempealeau, and Buffalo river basins were compared with data from the 1900-31 and the 1958-74 periods. Twenty-six species were collected which had not been previously reported from the Black River basin, 15 from the Trempealeau River basin, and 13 from the Buffalo River basin. Two species have apparently been extirpated from the Black River basin, 8 from the Trempealeau River basin, and 13 from the Buffalo River basin. The continued use of this data base for the preparation of environmental impact assessments, for the development of master plans for the aquatic resource, and for research on nongame species, fish communities, and ecosystems is recommended. (Geiger-PTT)
W88-00877

REVIEW OF ENVIRONMENTAL CONSEQUENCES OF WATERWAY DESIGN AND CONSTRUCTION PRACTICES AS OF 1979,
Vanderbilt Univ., Nashville, TN. Dept. of Environmental and Water Resources Engineering.
E. L. Thackston, and R. B. Sneed.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-118078. Price codes: A05 in paper copy, A01 in microfiche. Technical Report E-82-4, April 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 92 p, 4 fig, 3 tab, 46 ref. Contract No. DACW39-78-M-5600.

Descriptors: *Environmental effects, *Channel improvement, *Literature reviews, *Flood plain management, Dikes, Floodways, Levees, Waterways, Revetments, Navigation, Wetlands, Vegetation, Water table, Erosion control, Sedimentation, Aesthetics, Aquatic habitats, Habitats, Species diversity, Water quality, Reservoirs, Flood plain zoning, Stream banks, Bank protection, Protection.

Waterway projects designed and constructed by the Corps of Engineers (CE) include dikes, revetments, levees, and channel modifications for flood control and navigation purposes. A review of existing CE design guidance in the form of Engineer Manuals (EMs) and personal contacts with CE field offices was performed to appraise current practices regarding consideration of environmental effects in the design and construction of waterway projects. A computer-assisted review of technical literature was also performed in order to determine observed adverse environmental effects of waterway projects. Possible adverse effects presented in the literature included wetlands drainage, loss of native vegetation, cutoff of oxbows and meanders, water table drawdown, increased erosion and sedimentation, and change of aesthetics. Other possible effects on the aquatic system may include the loss of aquatic habitat, productivity, and species diversity, and the degradation of water quality. Alternatives to traditional channel modification were identified through the literature review. Structural alternatives to channel modification include levees, floodways, reservoirs, and land treatment measures. Additional alternatives include various forms of flood plain management; flood plain zoning; construction of bypass channels around sensitive wetland areas; construction of numerous, very small, water-retention structures; and substitution of clearing and snagging, or only snagging, for complete channelization. Current efforts to minimize adverse environmental effects of dikes were also investigated. (Author's abstract)
W88-00886

TECHNIQUES FOR REAERATION OF HYDROPOWER RELEASES,
Tennessee Valley Authority, Knoxville. Div. of Water Resources.
C. E. Bohac, J. W. Boyd, E. D. Harshbarger, and A. R. Lewis.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-126771. Price codes: A08 in paper copy, A01 in microfiche. Technical Report E-83-5, February 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 164 p, 7 fig, 143 ref, 2 append.

Descriptors: *Reaeration, *Dissolved oxygen, *Hydroelectric power, *Literature review, Turbines, Aerators, Reservoirs, Reviews, Model studies, Legal aspects, Planning, Destratification.

The results of a literature search on methods of aerating hydropower releases are presented. Turbine venting at hydroelectric projects to reaerate reservoir releases was first used in the US in Wisconsin 30 yr ago. Turbine venting configurations reviewed include oxygen diffusers in the turbine flow, air aspiration into the draft tube below the turbine wheel, and mechanical injection with the use of compressors. The amount of oxygen transferred to the water depends on air or oxygen flow, water flow, mixing time, degree of turbulence and

dissolved oxygen (DO) deficit (the difference between the saturation DO concentration and the unaerated DO concentration). Turbine venting by aspiration occurs when subatmospheric pressure (vacuum) in the draft tube draws air in to mix with the turbine flow. Many turbines for which data are reported had accommodations for venting. The oxygen concentration was increased by 1 to 4 mg/L with this method. A vacuum often exists below the turbine at low water-flow rates but decreases with increasing flow rates. Turbines are sometimes throttled to only a fraction of their capacity to maintain aspiration capabilities. Deflector plates on the draft tube wall and on the hub or runner cone of Francis turbines can aspirate air flows of as much as 3% of water flow, with associated DO increases > 4 mg/L at minimum turbine discharges. Compressed air injection into the draft tube is used when hydraulic conditions do not permit the use of the aspirating type of turbine venting. Compressed air confines power reduction to only the period of aeration, but it is more capital-intensive than baffles. (Cutty-PTT)
W88-00887

EFFECTS OF RESERVOIR RELEASES ON WATER QUALITY, MACRO-INVERTEBRATES, AND FISH IN TAILWATERS: FIELD STUDY RESULTS,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
C. H. Walburg, J. F. Novotny, K. E. Jacobs, and W. D. Swink.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-126770. Price codes: A09 in paper copy, A01 in microfiche. Technical Report E-83-6, February 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 176 p, 5 fig, 37 tab, 18 ref.

Descriptors: *Reservoir releases, *Tailwater, *Fish, *Invertebrates, Flood control, Hydroelectric plants, Macroinvertebrates, Water quality, Dam effects, Sunfish, Sucker, Catfish, Trout, Water temperature, Water quality.

Studies were conducted at seven reservoirs in tailwaters below both flood-control and peaking hydropower projects. The invertebrate and fish communities in tailwaters were affected most by temperature, volume, and timing of discharges. The numbers of invertebrate and fish species were largest in tailwaters of flood control projects with warmwater release. Invertebrate populations were seasonally more stable, although less diverse, in tailwaters of hydropower projects than in tailwaters of flood-control projects. Hydropower projects provided a relatively constant downstream environment for the few species present. Periodic flood discharges in the tailwaters of flood-control projects severely altered the tailwater environment and disrupted the invertebrate community. Sunfish, suckers, and catfish were most important in tailwaters of flood-control projects; stocked trout provided the major fishery in the cold tailwaters of deep-release hydropower projects. Fish populations in the warmwater tailwaters were most similar to those in natural streams and were least affected by dam operations. Fish in cold tailwaters of deep-release hydropower projects were most affected by dam operations. The occurrence of diverse habitats in tailwaters may moderate the effects of dam operations on both invertebrates and fish. (Cutty-PTT)
W88-00888

EFFECTS OF RESERVOIR WATER LEVELS ON YEAR-CLASS DEVELOPMENT AND THE ABUNDANCE OF HARVESTABLE FISH,
Aquatic Ecosystem Analysts, Fayetteville, AR.
G. F. Ploskey, and L. R. Aggus.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-158040. Price codes: A03 in paper copy, A01 in microfiche. Technical Report E-85-5, June 1985. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 33 p, 9 fig, 2 tab, 7 ref, append.

Descriptors: *Environmental effects, *Fish, *Reservoirs, *Water level, *Virginia, Aquatic habitats, Mortality, Predation, Fish harvest, Fish populations, Bull Shoals Lake, Arkansas, John H. Kerr Lake.

This report supplements Technical Report E-84-8, which documented the quantitative relations between seasonal and annual water levels and the reproductive success of fishes in reservoirs. In this study development of year classes of fish in reservoirs was examined in detail to clarify the effects of fish reproductive success on the future abundance of fishes of a harvestable size. The increased production of young fish consistently increased the abundance of harvestable-size fish within 1-4 years, barring a catastrophe. Mortality was the single most important variable affecting the production of harvestable fish. Manipulating reservoir levels during the growing season can often reduce major causes of mortality such as starvation and predation. Above normal water levels caused by extensive spring flooding and above-normal summer water levels reduce mortality of young fish by providing additional refuge from predators. The degree to which a single year class of fish dominates a population is influenced by the extent of annual and multiyear changes in water levels. In Bull Shoals Lake, Arkansas, where water levels changed extensively within and among years, fish showed markedly nonuniform patterns of recruitment into the harvestable size class. In John H. Kerr Lake, Virginia, where water levels varied less extensively, annual recruitment of fish was more uniform. (Cassar-PTT)
W88-00889

HABITAT SUITABILITY INDEX MODELS: JUVENILE ATLANTIC CROAKER,
Virginia Inst. Of Marine Science, Gloucester point. Dept. of Invertebrate Ecology.
For primary bibliographic entry see Field 5C.
W88-00899

POTENTIAL EFFECTS OF KAPLAN, OSSBERGER, AND BULB TURBINES ON ANADROMOUS FISHES OF THE NORTHEAST UNITED STATES.
Fish and Wildlife Service, Newton Corner, MA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-158410. Price codes: A07 in paper copy, A01 in microfiche. Report FWS/OBS-82/62, September 1982. Final Technical Report. DOE/DOI-F&WS-20733-3. Edited by William E. Knapp, Boyd Kynard, and Steven P. Gloss. 132 p, 129 ref.

Descriptors: *Environmental effects, *Turbines, *Fish, Mortality, American salmon, Salmon, Blueback herring, Herring, American shad, Shad, Striped bass, Bass.

Several studies of fish mortality in turbines showed that effective experimental approaches were not always interchangeable among different study sites. At the 17 MW Kaplan turbine at Holyoke Dam, Massachusetts, acute mortality of juvenile American shad and blueback herring as 63% at 16.5 MW, 83% at 12.0 MW, and 83% at 5.5 MW. Laboratory experiments indicated extreme sensitivity of blueback herring to scale loss as low as 8-10%. Adult American shad had a 50% mortality at five hours; Atlantic salmon smolts had a 4.9% mortality within 2 hours. In Ossberger turbines juvenile American shad experienced 50% acute mortality passing through a turbine at 320-540 KW. Striped bass mortality of rainbow and steelhead trout was predicted at 24-62% depending on size. Fish which died within 48 hours had a 7% higher scale loss than control fish. In 7.8 MW bulb turbines 5-hour mortality of two-year old Atlantic salmon smolts was less than 2%. (See W88-00904 thru W88-00907) (Cassar-PTT)
W88-00903

POTENTIAL EFFECTS OF KAPLAN TURBINES ON ATLANTIC SALMON SMOLTS, AMERICAN SHAD AND BLUEBACK HERRING,
Massachusetts Cooperative Fishery Research Unit, Amherst.
B. Kynard, R. Taylor, C. Bell, and D. Stier.
Available from the National Technical Information Service, Springfield, VA 22161. IN: Potential Effects of Kaplan, Ossberger, and Bulb Turbines on Anadromous Fishes of the Northeast United States, FWS/OBS-82/62, September 1982. p 5-50, 9 fig, 11 tab, 2 append.

Descriptors: *Environmental effects, *Turbines, *Fish, American shad, Shad, Blueback herring, Herring, Atlantic salmon, Salmon, Mortality.

The turbine-related mortality of juvenile and adult American shad (Alosa sapidissima), juvenile blueback herring (Alosa aestivalis), and Atlantic salmon (Salmo salar) smolts was investigated at the 17 MW Kaplan turbine at Holyoke Dam on the Connecticut River in Massachusetts. Mean acute turbine mortality of juvenile shad and herring was 62.95% at a generation level of 16.5 MW, 83.03% at 23.0 MW, and 82.50% at 5.5 MW. With adults, statistically significant information was not obtained. There was no statistical difference in mortality rates between control and test salmon smolts introduced into the turbine. (See also W88-00903) (Cassar-PTT)
W88-00904

POTENTIAL EFFECTS OF OSSBERGER TURBINES ON ATLANTIC SALMON SMOLTS, STRIPED BASS AND AMERICAN SHAD,
New York Cooperative Wildlife Research Unit, Ithaca.
S. P. Gloss, J. R. Wahl, and R. B. DuBois.
Available from the National Technical Information Service, Springfield, VA 22161. IN: Potential Effects of Kaplan, Ossberger, and Bulb Turbines on Anadromous Fishes of the Northeast United States, FWS/OBS-82/62, September 1982. p 51-90, 13 fig, 11 tab, append.

Descriptors: *Environmental effects, *Turbines, *Fish, Shad, Bass, Salmon, Ossberger turbines, Mortality, Striped bass.

Fish mortality in 650 and 850 MW Ossberger cross-flow turbines was studied at a low-head small-scale dam on the Susquehanna River in New York. Mortality of Atlantic salmon was strongly size dependent. Ossberger turbines produced higher mortality than previously reported in Francis and Kaplan turbines. Bass and shad were much more sensitive to turbine passage than salmonids. (See also W88-00903) (Cassar-PTT)
W88-00905

POTENTIAL EFFECTS OF BULB TURBINES ON ATLANTIC SALMON SMOLTS,
Fish and Wildlife Service, Newton Corner, MA.
A. E. Knight, and D. M. Kuzmeskus.
Available from the National Technical Information Service, Springfield, VA 22161. IN: Potential Effects of Kaplan, Ossberger, and Bulb Turbines on Anadromous Fishes of the Northeast United States, FWS/OBS-82/62, September 1982. p 91-98, 3 fig.

Descriptors: *Environmental effects, *Turbines, *Fish, Salmon, Bulb turbines, Mortality.

Of 25 radiotagged Atlantic salmon, 22.5 to 35.0 cm, introduced into a bulb turbine operating at 7.8 MW, 23 apparently survived for 5 hours after turbine passage. The study location was Essex Dam, on the Merrimac River at Lawrence, Massachusetts. (See also W88-00903) (Cassar-PTT)
W88-00906

POTENTIAL EFFECTS OF SCALE LOSS ON MORTALITY OF ATLANTIC SALMON AND JUVENILE CLUPEIDS,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
P. Kostecki, and B. Kynard.
Available from the National Technical Information Service, Springfield, VA 22161. IN: Potential Effects of Kaplan, Ossberger, and Bulb Turbines on Anadromous Fishes of the Northeast United States, FWS/OBS-82/62, September 1982. p 99-114, 5 tab.

Descriptors: *Environmental effects, *Turbines, *Fish, Ossberger turbines, Blueback herring, Herring, Atlantic salmon, Salmon, Mortality.

Atlantic salmon smolts passed through an Ossberger turbine lost an average of 6834 sq mm of their scaled surface. Three body zones were considered: Zone 1 was the tail region, Zone 2 was the back region, and Zone 3 was the stomach region. Fish surviving up to 48 hours had lost significantly more total scales than the control fish and those surviving more than 48 hours. Significantly greater amounts of scales were lost from zones 1 and 2 than from zone 3. In the laboratory, scales were removed from salmon smolts to study survival rates. In 192-hour studies, survival in fresh water was 192 hours for fish with zero to 17.7% of scales removed; 188 hours for 18.0% of scales removed; and 164.2 hours for fish with 26.6% of scales removed. Removal of scales from juvenile blueback herring in the laboratory showed extreme sensitivity to scale loss. Scale loss as little as 8.5% of the total scaled surface area resulted in significant decreases in survival. The longest period of survival of any group other than the controls was 43.2 hours. Sensitivity to scale loss was greatest in the stomach area and least in the tail area. (See also W88-00903) (Cassar-PTT)
W88-00907

7. RESOURCES DATA

7A. Network Design

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART 2. CASE STUDIES,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 7B.
W88-00016

STATISTICAL PREDICTION INTERVALS FOR THE EVALUATION OF GROUND-WATER QUALITY,
Illinois State Psychiatric Inst., Chicago.
R. D. Gibbons.
Ground Water GRWAAP, Vol. 25, No. 4, p 455-465, July-August 1987. 6 tab, 16 ref.

Descriptors: *Statistical analysis, *Statistical methods, *Prediction intervals, *Groundwater quality, *Groundwater, Water quality, Mathematical studies, Mathematical equations, Monitoring, Wells, Statistics.

Factors for a normal distribution are given such that one may be 99% confident that the two-sided prediction interval xbar plus or minus rs or the one-sided prediction interval xbar + rs will contain all of the k future values, where xbar and s are the sample mean and standard deviation obtained from n previous values. In the context of groundwater monitoring, the future samples may represent new monitoring values at each of k downgradient wells, and the n previous values might be the historical monitoring results for one or more upgradient wells. The Tables provided allow the computation of one-sided and two-sided 99% prediction intervals for previous sample sizes of n = 4 to 100 and future samples of k = 1 to 100. Modification of these intervals for log-normally distributed data is also presented. (Author's abstract)
W88-00019

EVALUATION OF WET CHEMICAL DEPOSITION IN NORTH AMERICA,
Colorado State Univ., Fort Collins. Natural Resources Ecology Lab.
For primary bibliographic entry see Field 5B.
W88-00223

ACIDIC POLLUTANTS IN AIR AND PRECIPITATION AT SELECTED RURAL LOCATIONS IN CANADA,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W88-00224

COMBINED ANALYSIS OF AIR QUALITY AND PRECIPITATION CHEMISTRY DATA,
Environmental Research and Technology, Inc., Westlake Village, CA.
For primary bibliographic entry see Field 5B.
W88-00225

OSCAR EXPERIMENT,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-00228

GLOBAL WATER QUALITY MONITORING,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W88-00407

TEXAS AIR CONTROL BOARD NATIONAL WEATHER SERVICE HOURLY CLIMATOLOGY SYSTEM: SUPPORT ACTIVITIES REPORT.
Texas Natural Resources Information System, Austin.
TNRIS-005, August 1978. 21 p, 9 fig, 3 ref.

Descriptors: *Weather data collections, *Computer programs, *Networks, *Data acquisition, *Air pollution, Precipitation, Computers, Meteorological data collections, Wind velocity, Monitoring, Data collections, Wind pressure, Clouds, Humidity, Air temperature, Network design, Climatology, Weather.

The Texas Air Control Board (TACB) has developed a National Weather Service (NWS) Hourly Climatological Data System. This system consists of computer programs designed to maintain files of hourly weather data and to generate reports from these files. The files which consists of hourly readings at approximately 50 Texas stations record data on wind direction and speed, barometric pressure, wet and dry bulb temperatures, cloud conditions, humidity, and precipitation intensity. The Texas Natural Resource Information System (TNRIS) support role in this project consisted of assisting the TACB in transferring technology to the TNRIS Data Bank facilities. Both computer systems analysis and programming support were provided to effect the transfer. One new program was added to the NWS Hourly Climatological System by TNRIS personnel. This program allows gaps in the period to be filled in. An Operator's Manual was also written in compliance with established TNRIS procedures and the system was turned over to TNRIS for handling routine data requests. The TACB uses the data tapes to obtain climatological data for specific dates for TACB personnel, to merge weather data from specific date/time groups with unusual or prespecified concentrations of pollutants, and for dispersion modelling programs. Project benefits and costs, and on-going activities of the system are discussed. (Geiger-PTT)
W88-00667

COMPUTER BASED MAPPING SYSTEM: USE REFERENCE MANUAL.
Texas Natural Resources Information System, Austin.
TNRIS-035, October 1983. 39 p, 12 fig, 2 append.

Descriptors: *Land use, *Computer programs, *Data acquisition, *Soil types, *Mapping, Computers, Networks, Data collections, Data interpretation, Data storage and retrieval, Monitoring, Geography, Natural resources, Vegetation.

The Computer Based Mapping System (CBMS) has been developed by the Texas Natural Resources Information System (TNRIS) for the Soil Conservation Service (SCS), U.S. Department of Agriculture (USDA), as a subsystem of the TNRIS Geographic Information System (GIS) to inventory, store, monitor and report soils and land use information. The System maintains a data base of soil mapping units and land use classifications. The data are coded using 15.44 acre (6.25 hectare) grids. Interpretive maps are produced by the computer, based on coded tables provided by the user, relating land use or soils codes to a particular interpretation on a one-to-one basis. A report is also available showing the number of occurrences, acreage, and percentage of coverage for each soil or land use code for a specific county. Instructions for the use of CBMS are provided. Examples of the various output products are included. (Author's abstract)
W88-00668

ONLINE ACCESS TO SELECTED SOCIOECONOMIC DATA: SUPPORT ACTIVITIES REPORT.
Texas Natural Resources Information System, Austin.
TNRIS-026, April 1981. 17 p, 4 fig, 3 tab, append.

Descriptors: *Computer programs, *Automation, *Data storage and retrieval, *Baseline studies, *Social aspects, Economic aspects, Data acquisition, Coastal zone management, Bays, Estuaries, Surveys, Computers, Data transmission.

The Texas System of Natural Laboratories, Inc. (TSNL) is a nonprofit corporation organized to provide ecology laboratories and facilities to the state's general academic institutions. The TSNL Laboratory Index Series publications are coordinated sets of baseline physical and biological data for Texas which include socio-economic data. The TSNL staff also are developing regional inventories of baseline data by county, latitude/longitude, and species. The pilot regional inventory covers 36 Texas coastal counties, the Texas submerged lands, Texas bays and estuaries, and the contiguous Gulf of Mexico. All the unit and regional inventories are based on an interdisciplinary, International Baseline Data Coding System developed by TSNL in consultation with experts from both the academic and research government communities. The Texas Natural Resources Information System (TNRIS) entered into a joint project with TSNL to automate selected portions of the data included in the Gulf Coast Index, as a pilot effort. As a result of this pilot project, a variety of socioeconomic data have been made accessable for online access by TNRIS computer terminals. Data made available in this manner include several existing tables from the TSNL regional index entitled 'Human Ecology' (1978). Additional small area 1970 Census data which was previously available from TNRIS computer files, but not in an online environment was also included in the project. TNRIS and TSNL plan to continue the policy of informal coordination including referral of users to appropriate data sources. It is likely that 1980 Census data will be available on the Monitor. (Geiger-PTT)
W88-00673

7B. Data Acquisition

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART 2. CASE STUDIES,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
J. F. Keely, and K. Boateng.
Ground Water GRWAAP, Vol. 25, No. 4, p 427-439, July-August 1987. 12 fig, 2 tab, 14 ref.

Descriptors: *Monitoring wells, *Well installation, *Purging techniques, *Sampling, *Path of pollutants, Water pollution sources, Installation, Wells, Drilling, Aquifers.

Three case histories are presented to illustrate the problems encountered using some monitoring well installation, purging, and sampling techniques. Hollow-stem augering posed problems during the installation of monitoring wells in terms of potential for cross-contamination of strata, the inability to emplace an adequate filter pack, the potential for smearing natural clays into sand and gravel strata, and the possible need for excessive purging of sediments that accumulate between sampling events. Cable tool drilling allowed construction of high quality wells, but was slow and expensive.

Concern over the potential for increased emissions of noxious vapors from the borehole when drilling with the air rotary method prevented its use in situations where highly contaminated strata were likely to be encountered. A hybrid drilling technique, augering with temporary casing, provided the advantages and minimized the disadvantages of the foregoing drilling methods. The installation of vertically separated clusters of monitoring wells lent important insights into the potential movement of a contaminant plume. Detailed aquifer tests provided needed information on the hydraulic behavior of the subsurface strata occupied by the plume so that potential pathways of contaminant transport could be identified accurately. Obtaining reliable data from such tests depended greatly on the ability of each monitoring well to act as a high quality hydraulic observation well. The selection of drilling and installation techniques that ensured minimal disturbance of the near-borehole environment provided the best guarantee of such performance. (Author's abstract)
W88-00016

DESIGN OF A GROUND-WATER SAMPLER FOR COLLECTING VOLATILE ORGANICS AND DISSOLVED GASES IN SMALL-DIAMETER WELLS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
R. L. Johnson, J. F. Pankow, and J. A. Cherry.
Ground Water GRWAAP, Vol. 25, No. 4, p 448-454, July-August 1987. 3 fig, 10 ref.

Descriptors: *Sampling, *Sample preservation, *Volatile organic compounds, *Dissolved gases, *Data acquisition, *Groundwater pollution, Test wells, Groundwater, Water sampling, Organic compounds, Pollutants.

A sampling device is described which collects groundwater samples containing volatile organic compounds and dissolved gases. The device protects the samples from volatilization losses from the time of collection until the time of analysis. It can be produced in a wide range of sizes and allows access to wells with inside diameters as small as one centimeter. The sampler is designed to be lowered in a well to the desired depth, depressurized to slightly below the in situ pressure to allow entry of the sample, and then repressurized prior to being returned to the surface. During collection and storage, the sample is exposed only to copper and stainless steel. An optional quartz prefilter can also be used. Crimping sections at both ends of the sample reservoir seal the pressurized sample during its return to the laboratory. The sampler is designed to be interfaced to analytical instruments for the direct, quantitative transfer of all analytes. (Author's abstract)
W88-00018

USE OF MICROCOMPUTERS FOR LABORATORY INVESTIGATIONS OF TURBINE-GENERATOR UNITS,
For primary bibliographic entry see Field 8C.
W88-00051

SAMPLING FOR WATER QUALITY CONTROL,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
For primary bibliographic entry see Field 5F.
W88-00064

EXPERIMENTAL METHODS FOR THE DETERMINATION OF THE PROPERTIES OF SALINE WATER,
National Engineering Lab., East Kilbride (Scotland).
D. T. Jamieson.
Desalination DSLNAH, Vol. 59, p 219-240, August 1986. 5 fig, 11 tab, 24 ref.

Descriptors: *Saline water, *Water analysis, *Water quality, *Desalination, Seawater, Brackish water, Scale formation, Artificial seawater, Feedwater, Density, Diffusion coefficient, Heat capacity, Adiabatic calorimetry, Drop calorimetry, Differential heating, Thermal conductivity, Boiling point elevation, Viscosity.

The relative proportions of salts in salt water are of great importance in desalination plants where the feedwater must be treated to prevent scale formation. It is therefore necessary to know both the total quantity of salts present and their relative amounts for all types of feedwater. The experimental methods for the determination of saline water composition and physical properties such as density, diffusion coefficient, heat capacity, thermal conductivity, vapor pressure, and viscosity are discussed. References to detailed descriptions of experimental methods are included. (Main-PTT)
W88-00087

SIMPLE WET-ONLY RAINFALL COLLECTOR,
Newcastle Univ. (Australia). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W88-00097

INTER-STORM COMPARISONS FROM THE OSCAR HIGH DENSITY NETWORK EXPERIMENT,
For primary bibliographic entry see Field 5B.
W88-00120

SIMPLIFIED WET-ONLY AND SEQUENTIAL FRACTION RAIN COLLECTOR,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
S. J. Vermette, and J. J. Drake.
Atmospheric Environment ATENBP, Vol. 21, No. 3, p 715-716, March 1987. 3 fig, 3 ref.

Descriptors: *Samplers, *Sampling, *Rain gages, *Precipitation, Precipitation scavenging, Rainstorms, Rainfall, Rainfall index, Net rainfall, Precipitation rate.

A simple and inexpensive way for a wet-only and passive sequential rainfall sampler was designed as a modification to the plastic Atmospheric Environment Service standard Canadian rain gauge. The components consist of a plastic lid hinged to the sampler housing, a spring, and a one-ply degradable tissue which keeps the lid closed. Before a rain event, the gauge orifice is covered and any dry deposition cannot enter the gauge. (Master-PTT)
W88-00121

SATELLITE-OBSERVED CHARCTERISTICS OF WINTER MONSOON CLOUD CLUSTERS,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W88-00126

PRELIMINARY INVESTIGATION OF A RELATIONSHIP BETWEEN SOUTH AMERICAN SNOW COVER AND THE SOUTHERN OSCILLATION,
Nebraska Univ.-Lincoln. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W88-00128

SAMPLING ZOOPLANKTON IN SHALLOW MARSH AND ESTUARINE HABITATS: GEAR DESCRIPTION AND FIELD TESTS,
Florida Medical Entomology Lab., Vero Beach.
J. R. Rey, R. A. Crossman, T. R. Kain, F. E. Vose, and M. S. Peterson.
Estuaries ESTUDO, Vol. 10, No. 1, p 61-67, March 1987. 2 fig, 4 tab, 19 ref. NOAA Grant Nos. CM47, CM 73, and CM 93.

Descriptors: *Data acquisition, *Sampling apparatus, *Zooplankton, *Marshes, *Estuaries, Plankton, Sampling, Field tests, Indian River lagoon, Florida, Comparison studies.

Pump and net samplers for collecting zooplankton from very shallow marsh and estuarine habitats are described. Their use is illustrated with data obtained in salt marshes along the Indian River lagoon in east-central Florida. In general, both pump and net samplers were satisfactory for sampling zooplankton in these areas. Larger sample volumes were obtained with gear utilizing 202 micron mesh sizes than with gear using 63 micron mesh because the latter became clogged very quickly. Quantitative and qualitative similarity between samples collected with different gear was moderate to low. Comparison of the kinds and densities of taxa captured with the various gear indicate that a combination of techniques may be needed to ensure a proper description of the plankton communities of the area. (Author's abstract)
W88-00140

MICROPHYSICAL AND RADAR OBSERVATIONS OF SEEDED AND NONSEEDED CONTINENTAL CUMULUS CLOUDS,
Weather Bureau, Bethlehem (South Africa).
For primary bibliographic entry see Field 2B.
W88-00146

ASSESSMENT OF SATELLITE RAIN ESTIMATES FOR LARGE-SCALE, OPERATIONAL USE,
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Weather Research and Modification.
For primary bibliographic entry see Field 2B.
W88-00637

HYDROACOUSTIC BIOMASS ESTIMATION TECHNIQUES,
Oak Ridge National Lab., TN.
P. Kanciruk.
Available from the National Technical Information Service, Springfield, VA 22161, as NUREG CR-2838. Price codes: A13 in paper copy, A01 in microfiche. Environmental Sciences Division Publication No. 2019, ORNL/TM-8304, November 1982. 279 p, 44 fig, 1 tab, 430 ref, 3 append. Contract No. DOE 40-550-75.

Descriptors: *Monitoring, *Biomass, *Powerplants, *Sonar, *Acoustics, Fish populations, Surveys, Case studies, Data acquisition, Aquatic populations, Population density.

This report introduces the fisheries biologist to the use of hydroacoustic (sonar) biomass estimation techniques as possible assessment tools for powerplant aquatic monitoring programs. Background information on the physics of sound in the water and basic hydroacoustic equipment is examined. The hydroacoustic literature is reviewed with examples provided of successful method application toward a variety of monitoring and assessment goals. Case studies using hydroacoustics for general aquatic surveys in pelagic, coastal, and estuarine environments are presented. The results of a hydroacoustic user survey are listed in an appendix, along with an extensive, computer-indexed hydroacoustic bibliography. Hydroacoustic biomass estimation methods are quantitative, cost-effective stock assessment tools that provide data not obtainable with more traditional survey techniques. Hydroacoustic methods are particularly adaptable to monitoring programs at powerplant sites and should be strongly considered in designing operational monitoring systems. (Geiger-PTT)
W88-00654

APPLICATIONS FOR STATEWIDE AERIAL PHOTOGRAPHIC COVERAGE.
Texas Natural Resources Information System, Austin.
TNRIS-022, October 1980. 36 p, 4 fig, 1 ref, 2 append.

Descriptors: *Aerial photography, *Mapping, *Remote sensing, *Surveys, *Infrared imagery, Photography, Surveys, Cost analysis, Satellite technology, Maps, Data storage and retrieval, Data acquisition, Computers, Data collections.

Aerial photography has for many years provided one of the major sources of data for mapping and analysis of U.S. earth resources. Coverage of the

State of Texas lacks continuity due to variations in the localized nature of past efforts, differences in scale and date, and other factors. The TNRIS Task Force, made up of representatives from 16 state agencies, has conducted several surveys of its agencies, state universities, and other entities to determine possible interest in obtaining one-time statewide aerial photographic coverage. The results of these surveys show that statewide coverage with color-infrared film at a scale of 1:80,000, quad-centered and in stereo, could support a wide range of applications. In many cases, availability of such photography would provide substantial savings in time and costs compared to other methods. The estimated cost for flying, processing, and delivery to Texas of the original photography is $1,250,000. Many other types of products can be prepared from the original data set. Recovery of the data costs is possible through the sale of photographic products. Among the significant benefits is the fact that such photography would provide a unique statewide set of data which represents a baseline for comparison with other data, acquired at different times and under different circumstances, so that changes can be measured. The National High Altitude Photography Program (NHAPP), with somewhat different specifications that satisfy 12 Federal agencies, is expected to include some of eastern Texas in 1981. Total Texas coverage by the NHAPP will require 2 or 3 yr with repeat coverage about every 5 yr. (Author's abstract)
W88-00670

LANDSAT IN TEXAS STATE AGENCIES.
Texas Natural Resources Information System, Austin.
TNRIS-014, April 1979. (Reprinted July 1982). 18 p.

Descriptors: *Satellite technology, *Remote sensing, *Aerial photography, *Mapping, *Hydrologic data collections, Data collections, Data acquisition, Water resources development, Irrigation districts, Water supply development, Water quality management, Computers, Wildlife habitats, Wildlife management, Urban development, Land use, Reservoirs, Coastal zone management, Land management, Planning.

Texas state agencies are involved in a number of Landsat-oriented projects. Many of these are carried out through the Texas Natural Resources Information System (TNRIS). One of the most significant Landsat projects undertaken with TNRIS assistance has been the mapping of Texas Coastal Land Use and Land Cover. Results of the project indicated that Landsat provides sufficient detail and resolution for the inventory and monitoring of resources in the Texas Coastal Zone. Another Landsat project undertaken by a Texas State agency is the mapping of artificial reservoirs in the state by the Texas Department of Water Resources. The inventory supports the department's inspection and permitting responsibilities. The Texas Parks and Wildlife Department uses Landsat imagery checked against aerial photography and ground truth data to map wildlife habitats in the entire state. The Texas Water Quality Board has completed a non-detailed land use/land cover map of the state based on Landsat imagery. At the request of the Texas Forest Service, TNRIS has recently completed a pilot project for mapping East Texas forest resources with Landsat imagery. TNRIS has recently completed a pilot project to determine if computer-assisted techniques with Landsat data could accurately delineate the same types of urban land cover information made available through a project conducted by the Texas Department of Water Resources. Landsat imagery is being used in an inventory of play lakes in the Texan high plains. It will also be used to map irrigated areas and lake water quality. (Geiger-PTT)
W88-00672

GEOHYDROLOGICAL ASPECTS OF THE VRYBURG COMPARTMENT: THE DEVELOPMENT AND EVALUATION OF TECHNIQUES FOR THE DETERMINATION OF THE GROUND-WATER POTENTIAL IN THE SOUTHERN ORANGE FREE STATE AND NORTHERN CAPE PROVINCE; VOLUME 4,
Water Research Commission, Pretoria (South Africa).
For primary bibliographic entry see Field 2F.
W88-00793

RADIOTELEMETRY TRACKING AT LAKE CONWAY, FLORIDA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W88-00837

ENGINEERING GEOLOGY AND GEOMORPHOLOGY OF STREAMBANK EROSION: REPORT 3, THE APPLICATION OF WATERBORNE GEOPHYSICAL TECHNIQUES IN FLUVIAL ENVIRONMENTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
For primary bibliographic entry see Field 2J.
W88-00849

SUPPLEMENTAL GROUNDWATER SUPPLIES FOR SIX SMALL COMMUNITIES IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
V. Poole, and R. Vaiden.
Environmental Geology Notes 108, 1985. 34 p, 20 fig, 14 ref.

Descriptors: *Groundwater, *Aquifers, *Water supply development, *Illinois, Groundwater availability, Engineering, Water shortage, Electrical earth resistivity, Water supply.

Many small Illinois communities that depend on groundwater to supply their municipal water systems experienced water shortages during the drought of 1976-1977. In this supplemental geophysical assessment of the aquifers supplying groundwater to these towns, six communities were selected (on the basis of past shortages and projected needs) as sites for exploration programs to locate sites for new municipal wells. Electrical earth resistivity (EER) surveys were used extensively to evaluate the water-producing capacities of the glacial deposits and to provide a basis for recommendations for test-drilling locations. The EER procedure (which is based on the fact that when fresh water is present, the resistivities of coarse-grained sands and gravels are higher than those of finer grained sediments such as silts and clays) is described in detail. Each of the six areas studied is described in detail, a vertical electrical sounding (VES) profile is presented for each, and recommendations are made regarding favorable areas for future water resource exploration. (Halterman-PTT)
W88-00870

7C. Evaluation, Processing and Publication

PARAMETER ESTIMATION FOR UNSATURATED FLOW AND TRANSPORT MODELS - A REVIEW,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 2G.
W88-00006

RISK ANALYSIS AND TIME-DEPENDENT FLOOD MODELS,
Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Wasserwirtchaft.
For primary bibliographic entry see Field 2E.
W88-00007

LOCAL EFFECTS OF GROUNDWATER PUMPAGE WITHIN A FAULT-INFLUENCED GROUNDWATER BASIN, ASH MEADOWS, NYE COUNTY, NEVADA, U.S.A.,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2F.
W88-00008

SIMPLE RECURSIVE FORMULA TO REPLACE WILSON'S GRAPHICAL LAKE ROUTING,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
M. M. Khatep, and W. E. Bardsley.
Journal of Hydrology JHYDA7, Vol. 91, No. 3/4, p 371-372, June 15, 1987. 1 ref.

Descriptors: *Data interpretation, *Mathematical studies, *Recursive formula, *Routing, *Wilson's equations, *Lake routing, *Hydrographs, Lakes, Discharge hydrographs, Mathematical equations, Inflow hydrographs.

Graphical lake routing involves the construction of a diagram which represents an estimate of a discharge hydrograph at a natural lake outlet, given an observed or specified inflow hydrograph. The Wilson method was reviewed. A simple formula expressed in terms of a recursive formula is presented as an alternative to the Wilson formula. In addition to avoiding diagram construction, the formula lends itself to simple least-squares estimation of K (a storage constant with the dimension of time) given observed inflow and discharge hydrographs. The same estimation approach can be used for the more general multiparameter case, where K is expressed as some function of discharge. (Wood-PTT)
W88-00011

BENEFICIAL ASPECTS OF SEA-WATER INTRUSION,
Scarborough Coll., Westhill (Ontario).
For primary bibliographic entry see Field 4B.
W88-00013

VOCS IN GROUND WATER INFLUENCED BY LARGE SCALE WITHDRAWALS,
Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources.
For primary bibliographic entry see Field 5B.
W88-00014

LARGE DATA BASES AND REGIONAL GROUND-WATER QUALITY ASSESSMENTS - AN IOWA CASE STUDY,
Iowa Univ., Iowa City. Dept. of Geography.
R. Rajagopal.
Ground Water GRWAAP, Vol. 25, No. 4, p 415-426, July-August 1987. 3 fig, 9 tab, 31 ref.

Descriptors: *Data collections, *Data interpretation, *Groundwater quality, *Groundwater, Iowa, Water quality, Drinking water, Water quality standards, Pollutants, Monitoring.

Many state and federal agencies routinely collect groundwater quality data to meet a variety of objectives. The WATSTORE (Water Data Storage and Retrieval System) data files of the U.S. Geological Survey containing raw groundwater quality data from 4,388 wells and the MSIS (Model State Information System) data files of the U.S. EPA containing finished (blended and/or treated) groundwater quality data from 2,137 public water-supply sources are the only two large computer-coded data files on Iowa groundwater quality. These two data bases, by themselves, provide significant insights regarding the distribution of chemicals in different hydrogeological environments and the compliance status of PWS sources with reference to drinking water quality standards in Iowa. With minor modifications, these two data bases can be integrated to: (a) provide statistical, spatial, temporal, and geological summaries of observed groundwater quality; (b) determine the extent of exposed populations to various contaminants in their different concentrations; (c) provide necessary information to reduce the existing list of contaminants and include some of those that are not being monitored now; (d) identify gaps in current data-gathering efforts and set priorities for the various components of future monitoring programs; (e) identify potential linkages for the com-

bined use of groundwater quantity and quality, socioeconomic, land-use, and public health data; and (f) alert policy makers to potential groundwater quality problems facing the state. Some of the limitations of the two data bases and the need for integrating them are demonstrated by a comparative analysis and evaluation. (Author's abstract)
W88-00015

INTERFACE UPCONING DUE TO A HORIZONTAL WELL IN UNCONFINED AQUIFER,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 4B.
W88-00020

STOCHASTIC MODELING OF THE INSECTICIDE FENITROTHION IN WATER AND SEDIMENT COMPARTMENTS OF A STAGNANT POND,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-00021

STOCHASTIC CONSIDERATIONS IN OPTIMAL DESIGN OF A MICROCATCHMENT LAYOUT OF RUNOFF WATER HARVESTING,
Ben-Gurion Univ. of the Negev, Beersheva (Israel). Dept. of Industrial and Management Engineering.
For primary bibliographic entry see Field 3B.
W88-00024

OPTIMAL GROUNDWATER QUALITY MANAGEMENT UNDER PARAMETER UNCERTAINTY,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5G.
W88-00028

FROM FIELD DATA TO FRACTURE NETWORK MODELING: AN EXAMPLE INCORPORATING SPATIAL STRUCTURE,
Lawrence Berkeley Lab., CA. Earth Sciences Div.
For primary bibliographic entry see Field 2F.
W88-00032

STREAMBANK EROSION ALONG TWO RIVERS IN IOWA,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W88-00034

SIMULTANEOUS CONFIDENCE AND PREDICTION INTERVALS FOR NONLINEAR REGRESSION MODELS WITH APPLICATION TO A GROUNDWATER FLOW MODEL,
Colorado School of Mines, Golden. Dept. of Mathematics.
A. V. Vecchia, and R. L. Cooley.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1237-1250, July 1987. 5 fig, 4 tab, 23 ref, append.

Descriptors: *Statistical methods, *Data interpretation, *Model studies, *Regression analysis, *Nonlinear regression models, *Statistics, *Groundwater movement, Mathematical studies, Mathematical equations, Confidence intervals, Prediction intervals, Optimization, Wells, Leaky aquifers, Aquifers.

Methods are presented for computing three types of simultaneous confidence and prediction intervals (exact, likelihood ratio, and linearized) on output from nonlinear regression models with normally distributed residuals. The confidence intervals can be placed on individual regression parameters or on the true regression function at any number of points in the domain of the independent variables, and the prediction intervals can be placed on any number of future observations. All three types of intervals can be computed efficiently by using the same straightforward Lagrangian optimization scheme. The prediction intervals can be treated in the same computational framework as the confidence intervals by including the random errors as pseudoparameters in the Lagrangian scheme. The methods were applied to a hypothetical groundwater model for flow to a well penetrating a leaky aquifer. Three different data sets were used to demonstrate the effect of sampling strategies on the intervals. For all three data sets, the linearized confidence intervals are inferior to the exact and likelihood ratio intervals, with the latter two being very similar; however, all three types of prediction intervals yielded similar results. The third data set (time drawdown data at only a single observation well) points out many of the problems that can arise from extreme nonlinear behavior of the regression model. (Author's abstract)
W88-00035

THEORETICAL STUDY OF THE ESTIMATION OF THE CORRELATION SCALE IN SPATIALLY VARIABLE FIELDS: 1. STATIONARY FIELDS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
D. Russo, and W. A. Jury.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1257-1268, July 1987. 5 fig, 5 tab, 37 ref.

Descriptors: *Statistics, *Stochastic hydrology analysis, *Stationary fields, *Correlation, *Mathematical studies, *Statistical methods, *Soil water, *Solute transport, *Kriging, *Model studies, Data interpretation, Mathematical equations, Soil properties.

The correlation scale of the stochastic component of various soil properties plays an essential role in the interpolation of spatial phenomena using kriging techniques and in the solution of transport problems in heterogeneous media using stochastic modeling. The uncertainty of the estimation of the correlation scales of stationary fields was analyzed by generating realizations of a set of two-dimensional isotropic second-order stationary functions with given correlation scales. Results from simulations of 100 independent realizations showed that the variance of the estimate of the correlation scale decreases as the number of sample points n increases and when the size of the correlation scale of the underlying process relative to the field area decreases, whereas the bias decreases as n increases and the underlying correlation scale increases. Results of variogram model fitting and cross-validation tests involving single realizations showed that both the accuracy of the estimates of the correlation scales and the fitted variogram model consistency increase as both the sample points and the correlation scale of the underlying process increase. Analysis of the effect of the grid size on the estimates of the correlation scale showed that reasonable estimates can be obtained when the distance between the sampling points is smaller than half the range of the underlying process. Estimates of correlation scales based on data along transects may underestimate the correlation scale of the underlying process by a factor of 2 or greater. A comparison between different estimation procedures showed that in general estimates of both the variance and the integral scale provided by the restricted maximum likelihood procedure, which in turn, are higher than those provided by fitting the nonparametric estimates of the variogram using the minimum mean-square deviation criterion. Results of the objective model validation tests, however, implied that generally all these estimates are accurate and consistent with the data, suggesting that a given realization of a given stationary process may be adequately described by different sets of integral scale and variance. (See also W87-12123) (Author's abstract)
W88-00037

THEORETICAL STUDY OF THE ESTIMATION OF THE CORRELATION SCALE IN SPATIALLY VARIABLE FIELDS: 2. NONSTATIONARY FIELDS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
D. Russo, and W. A. Jury.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1269-1279, July 1987. 7 fig, 8 tab, 11 ref.

Descriptors: *Nonstationary fields, *Statistics, *Stochastic hydrology, *Kriging, *Correlation analysis, *Mathematical studies, *Statistical methods, Data interpretation, Model studies, Mathematical equations.

A nonstationary field may be viewed as a process composed of two components, a stochastic component characterized by a relatively small-scale, high-frequency variation, and a deterministic (drift) component characterized by a relatively large-scale, low-frequency variation. The estimation of the variogram or the covariance function and its associated correlation scale requires the prior estimation of the drift. The effects of the type of drift function, the size of the integral scale, and the variances associated with the two components on the estimation of the correlation scale were analyzed. A set of nonstationary fields was generated by superimposing different drift functions with a given variance on stationary fields with a given integral scale and variance. Results showed that the shape of the estimated variograms and their associated estimated correlation scales, the fractal dimensions, and the estimates of the covariance function provided by the parametric estimation procedures were affected by the type of imposed drift function, by the integral scale of the stochastic component, and by the ratio between the variances of the two components. Both the maximum likelihood (ML) and the restricted maximum likelihood (RML) estimation procedures may fail to correctly identify and separate the two components when their respective variances are of the same order of magnitude and when the correlation scale or spatial extent of the stochastic component is small compared with the typical size of the field domain. In general, the ML and the RML estimation procedures overestimated the integral scale and the variance of the underlying process, whereas the iterative generalized least squares and the ordinary least squares procedures coupled with the minimum mean-square deviation criterion for variogram model fitting underestimated the value of the integral scale. It was concluded that different sets of integral scale and variance values may adequately describe a given realization of the nonstationary field. Careful examination of the estimated variograms over the entire set of lag classes, application of fractal dimension analysis, and a validation test of the fitted variogram models are necessary steps for drift detection. (See also W87-12122) (Author's abstract)
W88-00038

MULTIDIMENSIONAL MODEL OF NONSTATIONARY SPACE-TIME RAINFALL AT THE CATCHMENT SCALE,
Princeton Univ., NJ. Water Resources Program.
For primary bibliographic entry see Field 2A.
W88-00040

NEAREST-NEIGHBOR METHODS FOR NONPARAMETRIC RAINFALL-RUNOFF FORECASTING,
American Telephone and Telegraph Co., Denver, CO.
For primary bibliographic entry see Field 2A.
W88-00041

ESTIMATION OF FLOOD FREQUENCY: AN EVALUATION OF TWO DERIVED DISTRIBUTION PROCEDURES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
M. S. Moughamian, D. B. McLaughlin, and R. L. Bras.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1309-1319, July 1987. 8 fig, 4 tab, 16 ref. NSF Grant 8513556-ECE.

Descriptors: *Rainfall-runoff relationships, *Flood forecasting, *Flood distribution techniques, *Technique evaluation, *Flood frequency, *Data interpretation, Distribution techniques, Comparison studies, Flood data, Flood forecasting, Distribu-

tion, Flow discharge, Watersheds, Rainfall, Mathematical equations.

The performance of two typical derived distribution techniques was examined. Flood frequency distributions obtained with each technique are compared to sample distributions estimated from measured discharge records. The comparison is based on over 40 years of discharge data from each of three different watersheds (North Nashua River in Massachusetts: USGS stream gaging station 01094500; Davidson River in North Carolina: station 03441000; and Santa Paula Creek in California). Input parameters required by the derived distribution methods were estimated from limited data sets to simulate conditions encountered in watersheds where rainfall and discharge records are available for only a few years. Both of the derived flood frequency methods performed poorly in every watershed when compared to sample distributions. This poor performance may reflect deficiencies in the probabalistic rainfall model and/or the watershed response models used in the two derived distribution methods examined. The results of the comparison suggest that fundamental improvements are needed before the derived distribution approach can be applied with any confidence. (Wood-PTT)
W88-00042

USE OF WEIGHTED INTEGRAL VARIABLES TO DETERMINE THE RELATION BETWEEN RAINFALL INTENSITY AND STORM FLOW AND PEAK FLOW GENERATION,
Melbourne Univ., Parkville (Australia). School of Agriculture and Forestry.
For primary bibliographic entry see Field 2A.
W88-00043

COUPLED THERMOMECHANICAL RESPONSE OF AN AXISYMMETRIC COLD ICE SHEET,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 2C.
W88-00044

ANALYSIS AND INTERPRETATION OF BOREHOLE HYDRAULIC TESTS IN DEEP BOREHOLES: PRINCIPLES, MODEL DEVELOPMENT, AND APPLICATIONS,
INTERA Technologies, Inc., Austin, TX.
J. F. Pickens, G. E. Grisak, J. D. Avis, D. W. Belanger, and M. Thury.
Water Resources Research WRERAQ, Vol. 23, No. 7, p 1341-1375, July 1987. 36 fig, 7 tab, 25 ref, append.

Descriptors: *Groundwater movement, *Pumping tests, *Aquifer testing, *Data interpretation, *Boreholes, *Model studies, *Borehole hydraulics, Hydraulic testing, Antecedent pressures, Antecedent temperatures, Pressure effects, Temperature effects, Mathematical studies, Mathematical equations, Mathematical models, Switzerland, Permeability coefficient.

A review of the literature on hydraulic testing and interpretive methods, particularly in low-permeability media, indicates a need for a comprehensive hydraulic testing interpretive capability. Physical limitations on boreholes, such as caving and erosion during continued drilling, as well as the high costs associated with deep-hole rigs and testing equipment, often necessitate testing under nonideal conditions with respect to antecedent pressures and temperatures. In these situations, which are common in the high-level nuclear waste programs throughout the world, the interpretive requirements include the ability to quantitatively account for thermally induced pressure responses and borehole pressure history (resulting in a time-dependent pressure profile around the borehole) as well as equipment compliance effects in low-permeability intervals. A numerical model was developed to provide the capability to handle these antecedent conditions. Sensitivity studies and practical applications are provided to illustrate the importance of thermal effects and antecedent pressure history. It is demonstrated theoretically and with examples from the Swiss regional hydrogeologic characterization program that pressure changes (expressed as hydraulic head) of the order of tens to hundreds of meters can result from 1-2 degrees C temperature variations during shut-in (packer isolated) tests in low permeability formations. Misinterpreted formation pressures and hydraulic conductivity can also result from inaccurate antecedent pressure history. Interpretation of representative formation properties and pressures requires that antecedent pressure information and test period temperature data be included as an integral part of the hydraulic test analysis. (Author's abstract)
W88-00045

NEW METHOD FOR THE REAL-TIME OPERATION OF RESERVOIR SYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 4A.
W88-00046

DISTRIBUTION AND COMMUNITY STRUCTURE OF THE BENTHIC FAUNA OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE DESCRIBED BY NUMERICAL METHODS OF CLASSIFICATION AND ORDINATION,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 2H.
W88-00047

PEATLAND HYDROLOGIC IMPACT MODEL: DEVELOPMENT AND TESTING,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 4C.
W88-00130

STORAGE COEFFICIENT DETERMINATION FROM QUASI-STEADY STATE FLOW,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W88-00131

DETERMINATION OF STEADY STATE DRAWDOWNS IN A HORIZONTAL DOUBLE AQUIFER SYSTEM: A NEW APPROACH,
Banaras Hindu Univ., Varanasi (India).
For primary bibliographic entry see Field 2F.
W88-00132

RESONANT REFLECTION OF WATER WAVES IN A LONG CHANNEL WITH CORRUGATED BOUNDARIES,
Cornell Univ., Ithaca, NY. High-Voltage Lab.
For primary bibliographic entry see Field 2E.
W88-00148

NATIONAL WATER SUMMARY 1985 - HYDROLOGIC EVENTS AND SURFACE-WATER RESOURCES.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W88-00556

DIGRD: AN INTERACTIVE GRID GENERATING PROGRAM,
Battelle Pacific Northwest Labs., Richland, WA.
H. P. Foote, W. A. Rice, and C. T. Kincaid.
Available from the National Technical Information Service, Springfield, VA 22161, as NUREG/CR-2845. Price codes: A04 in paper copy, A01 in microfiche. Report NUREG/CR-2845, PNL-4345, November 1982. 48 p, 15 fig, 1 tab, 11 ref, 3 append.

Descriptors: *Uranium mill tailings, *Computer models, Unsaturated flow, Leachates, Model studies, Graphical methods, Leaching, Flow.

Pacific Northwest Laboratory has completed the development and documentation of an interactive grid generating program (DIGRD, digitize grid). This program is designed to rapidly generate or modify grids necessary for the unsaturated flow code TRUST. In addition to the code, a user's manual was prepared. Unfortunately, the computer hardware that comprises the PNL interactive graphic capability is unique. Direct technology transfer is not possible, therefore, this report is intended to convey the utility of interactive graphics in supplying a grid generating capability. DIGRD has already been effectively used in the preparation of grids for the analysis of leachate movement from uranium mill tailings. The principle conclusion is that the interactive graphics employed in DIGRD are useful and economical in the development of complex grids. Grid generation activities that previously took between a half- and a full-man month can now be completed in less than a week. An improvement that DIGRD users have recommended is development of a uniform grid of either rectangles or equilateral triangles, which could be superimposed on any domain and then adjusted through the DIGRD program to match the boundaries of a tailings disposal facility. (Author's abstract)
W88-00657

DEVELOPING A DIGITAL BASE OF MAP INFORMATION FOR THE TEXAS NATURAL RESOURCE AGENCIES.
Texas Natural Resources Information System, Austin.
TNRIS-034, August 1983. 52 p, 5 tab, 10 ref, 3 append.

Descriptors: *Mapping, *Maps, *Computer programs, *Automation, *Computers, Contours, Topographic mapping, Topography, Roads, Rivers, Streams, Data interpretation, Data processing, Data collections, Water resources development, Natural resources.

In response to interests of the Texas Railroad Commission, the Texas Department of Water Resources (TDWR), and other State agencies, the Texas Natural Resources Information System (TNRIS) Task Force conducted a survey of State agency needs for computer mapping services. Emphasis was to be on possible needs for a uniform, automated, base map system to be used throughout State government. This report lists the map items or files which were suggested for automation, focussing on the nine items (road network, rivers and streams, topographic contours, etc.) which would logically constitute an automated base map system. These items could be automated through a Geographic Information System (GIS) for machine reproduction, scale and project changes, compositing, and numerous other manipulations. It is recommended that, after automating the base data files, the special purpose map files should be added to the system, as an ongoing process, as needed by the user agencies. The relative time and cost requirements of automating the various base data files through the GIS as currently configured and as it might be supplemented by outside contracts are considered. Upgrading the GIS would provide improved data entry capabilities, larger data base handling, generating new map products for State agency use, and greater response for user requests. Benefits of an automated mapping system for Texas state government would include access to efficient and rapid mapping services for the analysis and display of complex map data. (Geiger-PTT)
W88-00669

SAS BASED HYDROLOGIC INFORMATION STORAGE AND RETRIEVAL SYSTEM, PART I,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
M. Molnau, and M. J. Bluske.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197364/AS. Price codes: A04 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow. Completion Report, July 1986. 63 p, 13 fig, 9 ref. Contract No. 14-08-0001-G1014. Project

No. USGS G1014-32.

Descriptors: *Information storage and retrieval, *Hydrologic data, *Information systems, *Idaho, Water resources information, Climatic data, Computer programs.

A SAS based information management system was developed at Idaho University for the retrieval of hydrologic and climatic data. The new system will replace an existing system that has grown obsolete. A discussion is given of the current status of the project, and the remaining work to be accomplished. Descriptions of the overall design of the new system and of the SAS file structures are also presented. Also, examples are given of how to retrieve information from the new files. The objective of the project is to create a hydrologic data management system that is easy to use, maintain, and modify, and at the same time simulates the actions of existing system as much as possible, using the same simple command language, which can be learned by all users, regardless of their programming skills. Furthermore, maintenance programmers will be able to easily write new input formats, as well as make enhancements to the system for new applications. A final objective is to conduct workshops for users on how to make use of the system to retrieve hydrologic data. (USGS)
W88-00725

ALBERTA: SURFACE WATER DATA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 2E.
W88-00787

TEXAS NATURAL RESOURCES INFORMATION SYSTEM, WATER ORIENTED DATA BANK: SYSTEM CAPABILITIES.
Texas Natural Resources Information System, Austin.
For primary bibliographic entry see Field 10D.
W88-00796

SASKATCHEWAN: SURFACE WATER DATA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 2E.
W88-00798

OKLAHOMA'S WATER ATLAS, OKLAHOMA WATER RESOURCES BOARD.
Oklahoma Water Resources Board, Oklahoma City.
Publication No. 120, November 1984. 186 p, 9 fig, 51 maps, 24 plates, 26 ref.

Descriptors: *Rivers, *Lakes, *Water resources development, *Oklahoma, *Atlases, Groundwater, Ponds, Red River, Arkansas River, Reservoirs, Dams, Maps, Water quality, Precipitation, Temperature, Wells, Monitoring.

Oklahoma's water resources, particularly its rivers, figured prominently in its exploration, settlement, and economic development. Twelve major groundwater basins containing 320 million acre-feet of stored water underlie the state. Although most of the groundwater is of drinking water quality, some high sulfate waters are suitable only for irrigation. Brine infiltration is a problem in the oil and gas drilling regions. The state Water Resources Board reexamines the water quality standards every three years. In 1983 a groundwater monitoring program was initiated to define the chemical characteristics of water in 21 basins. Descriptions and statistics are given for major streams and their tributaries (Red River and Arkansas River) and for the lakes existing and under construction. The 206,680 farm ponds are indicated by county. The atlas includes maps of the water resources in 24 areas. (Cassar-PTT)
W88-00867

FISHERIES OF THE UNITED STATES, 1984.
National Fishery Statistics Program, Washington, DC.
Current Fishery Statistics No. 8260, April 1985. 121 p.

Descriptors: *Commercial fisheries, *Fisheries, *Sport fishing, Aquatic animals, Fishing, Economic aspects, Foreign trade.

The United States Department of Commerce presents a preliminary report for 1984 on the fisheries of the United States and foreign catches in the U.S. Fishery Conservation Zone. Important species are listed individually, with the total catch (in pounds) and the value being given for each. Per capita consumption is presented, as are data on the production of fresh, frozen and canned fishery products. Commercial fishery landings (catch) are listed for each state and for major U.S. ports. Information is also presented on marine recreational fisheries, with the estimated total number of fish caught by marine recreational fishermen being listed by species group, subregion, and mode of fishing. Foreign commercial catch is presented by species, country, and area. Imports are reported by item and country of origin, with exports by item and country of destination. Indexes of exvessel, wholesale, and retail prices are presented, as are data on fishery employment. (Halterman-PTT)
W88-00873

ECOLOGICAL CHARACTERIZATION OF THE CENTRAL AND NORTHERN CALIFORNIA COASTAL REGION. VOLUME IV: WATERSHEDS AND BASINS, CHAPTERS 17-29.
Jones and Stokes Associates, Inc., Sacramento, CA.
For primary bibliographic entry see Field 2E.
W88-00901

OCCURRENCE AND QUALITY OF GROUND WATER IN THE VICINITY OF BROWNSVILLE, TEXAS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W88-00930

OCCURRENCE, QUALITY AND AVAILABILITY OF GROUND WATER IN CALLAHAN COUNTY, TEXAS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W88-00932

OCCURRENCE, AVAILABILITY, AND QUALITY OF GROUND WATER IN TRAVIS COUNTY, TEXAS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W88-00933

GROUND-WATER AVAILABILITY OF THE LOWER CRETACEOUS FORMATIONS IN THE HILL COUNTRY OF SOUTH-CENTRAL TEXAS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W88-00934

OCCURRENCE, AVAILABILITY, AND CHEMICAL QUALITY OF GROUND WATER IN THE CRETACEOUS AQUIFERS OF NORTH CENTRAL TEXAS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W88-00935

OPERATIONAL, SPATIAL AND ENVIRONMENTAL WATER PLANNING AND ANALYSIS,
Michigan State Univ., East Lansing. Center for Remote Sensing.
For primary bibliographic entry see Field 5G.
W88-00943

8. ENGINEERING WORKS

8A. Structures

USE OF GLASS-FABRIC STRETCH MATERIAL FOR A FLEXIBLE JOINT OF PRECAST PIPE SECTIONS,
O. V. Mikhailov, V. N. Zaitsev, and V. V. Lgalov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 11, p 619-623, May 1987. 4 fig, 2 tab, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 11-13, November 1986.

Descriptors: *Pumped storage, *Pipes, *Precast pipes, *Pressure conduits, *Construction joints, Construction materials, Water conveyance, Hydraulic design, Performance evaluation, Pumping plants, Temperature effects, Russia.

The construction of pumped-storage stations with exposed large-diameter (6-10 m) precast steel conduits encased in reinforced concrete requires construction joints which can compensate for the motion of the conduit sections as a consequence of seasonal variation in temperature. Conduits of this type, and of large (7.5 m) diameter, are being used in the construction of the Zagorsk and Kaisiadorys pumped-storage stations in the USSR. The bell-and-spigot type joint has become the most prevalent application in these cases, but it brings with it a number of shortcomings, including high manufacturing cost, deformation of the rubber rings under the weight of the pipes, and rapid failure. New designs for flexible joints were investigated experimentally to determine performance. A U-shaped flexible joint connection made of glass-fabric impregnated with an epoxy-coal tar-Thiokol binder showed its high sealing properties and reliability at an internal pressure of up to 1.6 MPa. The use of U-shaped expansion joints substantially reduces the requirements imposed on the accuracy of manufacturing the ends of sections being joined as well as on their alignment during assembly. Fabrication of the expansion joint from glass-fabric stretch material is possible under on-site construction conditions. (Airone-PTT)
W88-00050

CERTAIN EFFECTS OF FLOW AERATION IN SPILLWAYS,
G. A. Chepaikin, and E. G. Donchenko.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 11, p 636-640, May 1987. 3 fig, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 13-17, November 1986.

Descriptors: *Spillways, *Closed-conduit flow, *Flow velocity, *Flow discharge, *Aeration, Design criteria, Hydroelectric plants, Flow characteristics, Cavitation, Dams, Aerators, Hydraulic design.

Deep tunnel and conduit spillways with free-flow outlet sections and involving air delivery from the atmosphere behind the main regulating gates are widely used in hydropower construction. Practical methods of calculating such spillways are based on experimental investigations of specific objects and on the chief equations of hydraulics of a one-dimensional, one-component flow with consideration of corrections obtained in experiments. Analysis of experimental data on flow characteristics in the discharge section behind the main gate reveals characteristics which cannot be explained within the framework of the methods being used, therefore requiring other approaches still in need of development. Two characteristic examples are discussed: the ejection effect of a high-velocity water flow (in a number of cases inside the initial and middle parts of the free-flow discharge section an increase of pressure is observed on the ceiling of the spillway in place of the expected decrease), and aeration of the discharge section of a spillway. (Airone-PTT)
W88-00053

EFFECT OF THE ACCURACY OF DETERMINING THE CHARACTERISTICS OF A ROCK

MASS ON CALCULATIONS OF TUNNEL LININGS,
N. S. Bulychev, N. N. Fotieva, and N. B. Kalinin.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 11, p 658-662, May 1987. 1 fig, 2 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 38-39, November 1986.

Descriptors: *Tunnel linings, *Rock properties, *Error analysis, Tunnels, Deformation, Tunnel construction, Underground structures, Errors, Mathematical analysis.

A mathematical analysis indicates how accuracy in the calculation of the modulus of deformation affects the accuracy of the calculation of a tunnel lining. The conventional model of a linearly deformable medium is used for the rock mass, and two types of effects (rock pressure and internal pressure) are examined for the case of a circular tunnel with a solid lining. In both instances the effect of error is greater in solid rock than it is in soft ground; however, it is also necessary to consider that the absolute values of the stresses in the linings of tunnels driven into rock are substantially smaller than in soft ground, and the permissible error of their calculated determination can be greater. Permissible error was not established in this investigation to the extent necessary for engineering recommendations. (Airone-PTT)
W88-00057

TECHNIQUE TO EVALUATE RISK OF EMERGENCY SPILLWAY CHANNEL EROSION,
J. S. Neathery.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 24, No. 1, p 9-14, February 1987. 2 fig, 1 tab, 6 ref.

Descriptors: *Spillway channels, *Dams, *Erosion, *Storm flow, Soils, Topography, Geology, Rocks, Soil maps, *Engineering structures, Dallas, Fort worth, Texas, Urban development, Engineering.

Evaluation of the risk of emergency spillway channel erosion at existing dam sites is needed due to the growth of urban areas on land surrounding these sites. An effective reconnaissance-level technique to assess the erosion risk due to storm flow in emergency spillway channels is needed to identify high risk channels. A proposed technique is based upon an evaluation of topography, geology, and soils, and involves the following steps: examination of the topography to determine the depth of cut and the existence of any topographic anomalies; determination of the rock type and structure along the floor and sides of the bedrock channel; and construction of a soil erosion map. These factors were evaluated at 12 emergency spillway channels in the Dallas-Fort Worth area. Predicted erosion risks, severe, moderate, or slight, obtained from this technique agreed with actual erosion experience during 1981 and subsequent floods. (Author's abstract)
W88-00072

TUNNEL PLUG DESIGN AT TYEE LAKE,
Morrison-Knudsen Engineers, Inc., San Francisco, CA.
J. Cogan, and F. C. Kintzer.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 24, No. 1, p 27-42, February 1987. 12 fig, 1 tab, 11 ref.

Descriptors: *Tunnel plugs, *Tunnels, *Tyee Lake, *Hydrofracturing, *Rock stress, *Tunnel leakage, *Rock splitting, *Engineering, *Tunnel design, Water leakage, Engineering structures, Rock, Power tunnels, Grouting, Pore pressure, Hydroelectric power, Alaska.

High head tunnel plugs must be designed to prevent plug failure as well as hydrofracturing of the surrounding rock. If the water pressure behind the plug exceeds the minimum rock stress, a fracture can develop in the rock which will propagate outward toward the hillside after which this fracture will become a leakage pathway. General criteria for positioning a plug to avoid rock splitting are discussed. The overall problem of sufficient cover for unlined tunnels in rock is thoroughly reviewed via case histories and various design approaches are described. Several reported plug failures are also discussed. Experience with the plug at the Tyee Lake Hydroelectric Project in southeast Alaska is presented. Operating under a water head of 1,338 ft, this plug is 12 ft wide by 10 ft high by 60 ft long and has an 84-in diameter penstock pipe passing through it. Mini-hydrofracturing tests were used to select the final plug location. Upon filling the tunnel, a water leakage rate of 31 gpm along the rock/concrete contact occurred. This was reduced to 11 gpm by regrouting. Piezometer measurements taken along the plug perimeter showed a sharp drop in pore pressure over the first 10 ft of plug. (Author's abstract)
W88-00073

DRAINAGE SYSTEM,
For primary bibliographic entry see Field 5E.
W88-00498

OFFSHORE INTAKE STRUCTURE,
W. R. Jenkner, A. E. Christie, E. E. M. Elsayed, J. S. Griffiths, and G. A. Mentes.
U.S. Patent No. 4,594,024; June 10, 1986. 10 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1067, No 2, p 684-685, June 10, 1986.

Descriptors: *Patents, *Water cooling, *Cooling water, *Intakes, *Powerplants, Offshore platforms, Entrainment, Reservoirs, Thermal powerplants, Nuclear powerplants, Industrial plants.

An offshore intake structure for a once-through water cooling system is supplied from a reservoir through a shaft. The reservoir comprises a lake or a river that is adequate to supply the cooling system for a thermal or nuclear generating station or other large industrial plant. A well excavated in the bed of the reservoir has a substantially flat bottom. A well outlet communicates with the intake shaft and is bounded by a peripheral wall system defining a horizontal submarine roof structure extending over the entire area of the well. The roof structure contains a perforated peripheral region defining an inlet to the well chamber and an imperforated central region. A horizontal radially converging flow passage extends from the wells chamber inlet to the intake pipe. Preferably the roof structure and supporting system are of modular precast construction. (Cremmins-AEPCO)
W88-00499

ARRANGEMENT FOR DAMMING WATER AND ALSO FOR DRAINING AWAY THE VOLUME OF WATER ABOVE A CERTAIN LEVEL IN VEGETATION-BEARING STRATUM,
H. Gilgen.
U.S. Patent No. 4,592,676; June 3, 1986. 4 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1067, No 1, p 212, June 3, 1986.

Descriptors: *Patents, *Draining terrace, *Drains, *Pipes, *Controlled drainage, *Water control, *Vegetation, *Drainage engineering, Subsoil drainage, Water transport, Sealants, Roofs.

Water is dammed and drained from vegetation in root protection and roof sealing systems. Water between a sealing layer and a root protection sheet is drained into an inlet channel. A pipe socket set with clearance in a channel is provided externally with a plate-like flange next to its upper edge and with a water-damming pipe arranged at an adjustable height in the pipe socket. The exterior of the pipe is sealed from the interior of the socket. The plate-like flange of the socket is joined and sealed from the roots to the edge of the root protection sheet surrounding a drainage hole in the sheet. (Cremmins-AEPCO)
W88-00500

MOISTURE IMPERVIENT BARRIER AND METHOD FOR MAKING SAME,
For primary bibliographic entry see Field 5G.
W88-00509

UNDERGROUND LEACHATE BARRIER AND METHOD OF MAKING SAME,
For primary bibliographic entry see Field 5E.
W88-00514

FLEXIBLE RETRACTABLE COLD WATER PIPE FOR AN OCEAN THERMAL ENERGY CONVERSION SYSTEM,
Lockheed Missiles and Space Co., Inc., Sunnyvale, CA.
J. G. Wenzel, and L. C. Trimble.
U.S. Patent No. 4,497,342; February 5, 1985. 22 p, 20 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1051, No 1, p 104, February 5, 1985.

Descriptors: *Patents, *Thermal power, *Energy conversion, *Cold springs, *Bottom water, *Pipes, Conduits, Water transport, Electric power, Thermodynamics, Water transport, Conveyance structures.

A flexible, retractable cold water pipe transfers ocean water to the surface for a thermal energy conversion system. A proximal end of the cold water pipe is secured to a floating structure (e.g., a ship or a moored platform) on the ocean surface, and a distal end of the pipe is extendible into the ocean to the selected depth. The cold water pipe comprises a tubular fabric membrane surrounded by annular shaping rings to which the fabric membrane is attached. When the cold water pipe is stowed in the surface structure, shaping rings form a stack of rings that are positioned one on top of the other and the fabric membrane is folded in accordion fashion inside the stack of rings. When the cold water pipe is fully, extended, the shaping rings are separated from each other at substantially equal intervals along the length of the fabric membrane. The shaping rings maintain the fabric membrane in circularly cylindrical configuration, and transfer the load of the cold water pipe to support cables when the pipe is deployed. The cold water pipe can be used with a closed-loop or an open-loop thermodynamic system to bring large quantities of cold water to the surface of the ocean. (Cremmins-AEPCO)
W88-00517

METHOD AND APPARATUS FOR PREVENTING FOREIGN OBJECTS FROM ENTERING INTO DOCKING BASINS,
Valmet Oy, Helsinki (Finland).
V. Koskivirta, and A. Haantera.
U.S. Patent No. 4,405,259; September 20, 1983. 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1034, No 3, p 1091-1092, September 20, 1983.

Descriptors: *Patents, *Docks, *Basins, *Floating ice, *Nozzles, *Obstruction to flow, *Flow control, Sluices, Water currents, Pumping.

A flow field is created on the surface of water in front of an inlet to a docking basin to prevent the entry of foreign objects, such as ice flows, into the basin. The flow field is formed by directing at least two strong, relatively narrow surface currents in an outward direction relative to the docking basin from the regions of the respective sides of the inlet. One of the surface currents is directed outwardly at a certain angle with respect to the transverse plane which passes through the inlet sides, the angle preferably being in the range between about 15 to 35 degrees. The other surface current is directed substantially rearwardly at right angles to the transverse plane which passes through the inlet sides. The equipment is provided in connection with floater-type vessels or the like whereby nozzle apparatus are installed in the region of the inlet to the docking space to direct the surface currents. (Cremmins-AEPCO)
W88-00519

TETHERED SUBMARINE PRESSURE TRANSFER STORAGE FACILITY FOR LIQUIFIED ENERGY GAS,
Cook, Stolowitz and Frame, Visalia, CA.
D. B. Harrison.

U.S. Patent No. 4,433,940; February 28, 1984. 6 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1039, No 4, p 1551, February 28, 1984.

Descriptors: *Patents, *Storage tanks, *Ocean bottom, *Submergence, *Pressure transfer, *Natural gas, *Liquid natural gas, Seawater, Cryogenics, Hazardous materials, Water pressure, Tethering.

An offshore submarine storage facility is tethered to the floor of the ocean or other large water bodies for storage of liquified energy gases and other materials at cryogenic temperatures. The facility includes a two part insulated submarine storage tank positioned at a selected depth in the water which defines an interior volume for storage of the liquid material. The two parts of the tank move in a slideably sealing engagement so that the interior volume tends to become reduced as the parts move together and thereby apply pressure. The two parts have major surfaces which are exposed to ambient sea water pressure in a way which transfers such pressure to the materials stored within the interior volume. The two parts also have mechanical pressure transfer equipment by which even more pressure may be transferred in a controlled amount to the materials stored within the interior volume. A flexible extensible, sea water impermeable membrane continuously extends from one of the parts to the other of the parts of the tank to define an enclosed envelope adjacent to the sealing surfaces of the two parts. A circulating balancing fluid located in the envelope provides further thermal insulation and transfers sea water pressure to the two parts. It also serves as a lubricant at the seal engagement of the two parts. A jacket tank containing balancing fluid around the exterior of the two part tank is provided. The balancing fluid is introduced at the top of the tank at ambient sea water temperatures and recirculates to maintain its liquid state and to reduce formation of ice at the seal region of the tank where the problems from the extreme thermal gradient are greatest. (Cremmins-AEPCO)
W88-00532

REVETMENT FOR PROTECTING THE INCLINED SURFACES OF BEACHES, SHORES, RIVERS OR CHANNELS, AND OF STRUCTURES SUCH AS MOLES, DIKES, OR CHANNEL WALLS, LOCATED IN THESE PLACES, AGAINST EROSION BY WAVES AND FLOWING WATER,
For primary bibliographic entry see Field 8D.
W88-00605

BEACH EROSION PREVENTION JETTY CONFIGURATION,
For primary bibliographic entry see Field 4D.
W88-00608

LIGHTWEIGHT SEMI-FLEXIBLE DIKE,
Shell Offshore, Inc., Houston, TX.
For primary bibliographic entry see Field 4D.
W88-00609

FLUID WAVE ENERGY DISSIPATING AND ABSORBING STRUCTURE,
For primary bibliographic entry see Field 4D.
W88-00610

FLOOD DISASTER CONTROL BAG,
For primary bibliographic entry see Field 4A.
W88-00611

SELF-ACTUATING WATER CONTAINMENT BARRIER,
For primary bibliographic entry see Field 4A.
W88-00612

PROCESS AND STRUCTURE FOR STORING AND ISOLATING HAZARDOUS WASTE,
Rollins Environmental Services, Inc., Wilmington, DE.
For primary bibliographic entry see Field 5E.
W88-00616

WATERSTOP FOR MONOLITH JOINTS,
Gelco Grouting Service, Salem, OR.
S. T. Waring.
U.S. Patent No. 4,626,133; December 2, 1986. 6 p, 7 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1073, No 1, p 290, December 2, 1986.

Descriptors: *Patents, *Concrete construction, *Grouting, *Construction joints, *Water pressure, Bonding, Concretes, Sealants, Adhesives, Dams, Powerplants, Locks, Resins.

A waterstop for monolith joints, which is readily installable under water pressure conditions, provides an effective seal to accomodate relative movement between adjacent monoliths. The waterstop is long lasting in service and can be repaired or replaced if necessary. A vertical hole down the joint between adjacent monoliths has a radial dimension such that the hole extends on each side of, or straddles, the joint. The waterstop is formed by a long, continuous, strong but flexible tube of heavy carrier material which is impregnated with adhesive, flexible, water-reactive resin and which is inserted in the hole and held tight against the wall of the hole by a flexible filler grout. The tube is bonded to a layer of fluid impermeable plastic. The tube with the felt carrier as the inside layer is saturated with the resin and then forced into the cut hole while being turned inside out by fluid pressure supplied from the inverting apparatus. This places the fluid impermeable layer on the inside of the tube and the resin saturated felt on the outside for bonding to defining walls of the hole. Sealing pressure for the resin is provided by the inverting fluid in the tube. With the tube fully installed in the hole, a filler of elastic chemical grout which is more dense than the inverting fluid is tremied into the hole to displace the inverting fluid and to form a permanent core which holds the impregnated felt tight against the wall of the hole. (Cremmins-AEPCO)
W88-00618

RCC DAM CONSTRUCTION AND METHOD,
Parrott, Ely, and Hurt, Lexington, KY.
D. L. Sexton, R. L. Hurt, and R. G. Lewis.
U.S. Patent No. 4,659,252; April 21, 1987. 6 p, 2 fig, 2 ref. Official Gazette of the United States Patent Office, Vol 1077, No 3, p 1529, April 21, 1987.

Descriptors: *Patents, *Concrete dams, *Roller compacted concrete, *Dam construction, *Dam stability, *Reservoirs, Leakage, Waterproofing, Polymers, Reservoir linings, Impervious membranes.

A roller compacted concrete (RCC) dam is constructed so as to limit or eliminate reservoir water leakage. The dam structure includes an upstream side of precast concrete panels assembled in edge-to-edge contact and directly retaining the water in the reservoir. The panels include a bonded impervious liner. A concrete curtain wall of conventional poured concrete is formed adjacent to the precast concrete panels and the liner. Layers of the RCC are spread adjacent to the poured concrete curtain wall to complete the dam. The liner is positioned between the precast concrete panels and the poured concrete curtain wall. The membranes are thus substantially isolated and protected from ambient conditions. The waterproof membranes may be made of any appropriate impervious material, such as a polyvinylchloride. (Cremmins-AEPCO)
W88-00619

CONDITION SURVEY OF DEPERE LOCK AND DAM, LOWER FOX RIVER, WISCONSIN,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 8F.
W88-00683

FOLDING PONTOON ARRANGEMENT,
F. G. Lundholm.
U.S. Patent No. 4,386,441; June 7, 1983. 4 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1031, No 1, p 8, June 7, 1983.

Descriptors: *Patents, *Bridges, *Floats, *Bridge construction, *Construction methods, Rafts, Ferries, Water wheels.

Pontoons pivotably interconnected for swinging about a hinge line adjacent to the plane of the upper sides are used for pontoon bridges, or as rafts and ferries. An internal chamber seated from the rest of the pontoon is situated against the end well adjacent to the hinge line pivot of the pontoon. A closable valve is on the outside of the pontoon at a place under the water surface in the floating position of the pontoon. When the pontoon assumes the floating position and the chamber is filled with air it forms a floating body with the remaining portions of the pontoon. If the valve is opened with the pontoon in this position, water flows into the chamber to cause loss of buoyancy under the hinge connection between the individual pontoons. This portion thus sinks down into the water and initiates the folding process of the pontoon pair. A crane is thus not required for this purpose. The folding of the pontoon pair is facilitated if at least one of the pontoons is provided with a weight situated adjacent to the side wall under the hinge line pivot and formed by at least one wheel. When a pontoon pair is folded, the wheel projects outside the end wall of one pontoon, so that the pair can rest on the wheel. (Cremmins-AEPCO)
W88-00746

DEVICE FOR LAP-JOINT ENGAGEMENT OF TWO BRIDGE ELEMENTS ON INTRADOS OR EXTRADOS AND BRIDGE ELEMENT COMPRISING IT,
Etat Francais, Paris (France).
M. E. Terrien, and C. Bouvet.
U.S. Patent No. 4,393,533; July 19, 1983. 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1032, No 3, p 81-82, July 19, 1983.

Descriptors: *Patents, *Bridges, *Bridge construction, *Floats, *Construction joints, *Construction methods.

A lap assembly engagement device lock two floating or fixed bridge elements together. A first bridge element comprises at least two retractable studs oriented obliquely with respect to the surface of the element, one on the intrados and the other on the extrados, so as to cooperate with a recess either of the extrados or of the intrados of a second bridge element. Bridge elements such as walkways, beams, joists, and ramps are extended from fixed or floating supports so as to construct a structure in which it is possible for vehicles to pass over any type of gap. An automatic interlock is installed after assembly to reduce the time required to place a bridge in use. (Cremmins-AEPCO)
W88-00747

BREAKWATER,
R. A. Hanson.
U.S. Patent No. 4,406,564; September 27, 1983. 8 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1034, No 4, p 1535-1536, September 27, 1983.

Descriptors: *Patents, *Breakwaters, *Concrete construction, Wave action, Buoyancy, Flotation, Prestressed concrete, Sea walls, Wave refraction.

A transportable, buoyant breakwater for maximum wave control comprises vertical, parallel prestressed concrete walls. The walls are spaced transversely apart from one another and have top and bottom horizontal edges. Horizontal longitudinal flotation cells are formed within each wall. Buoyancy within each cell provides the walls with a composite density slightly less than that of sea water. The walls float in a substantially submerged condition with the top horizontal edge at or slightly above the water surface. Connected between the walls and adjacent to their top horizontal edges are upper transverse elongated rigid members. Lower transverse elongated rigid members are operatively connected between the walls adjacent to their

bottom horizontal edges. The walls are held securely against the upper and lower elongated members by rigging under tension. (Cremmins-AEPCO)
W88-00748

METHOD FOR MAKING ELONGATE CAST CONSTRUCTION ON THE SEA,
E. Knutsen.
U.S. Patent No. 4,426,949; January 24, 1984. 5 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1038, No 4, p 1213, January 24, 1984.

Descriptors: *Patents, *Docks, *Floats, *Bridge construction, *Concrete construction, *Precast concrete, Drainage systems, Construction methods.

A floating dock is used for manufacturing a floating bridge or similar elongate, cast concrete constructions in a drainage. The dock contains upwardly and inwardly facing panels provided with a first set of stationarily arranged fastening members. The members locate anchoring for fastening board members having associated reinforcing in a first position in the dock for the casting of a first section of the construction. A second set of stationarily arranged fastening members in series with the first set fasten via corresponding anchoring at least portions of the first section. (Cremmins-AEPCO)
W88-00750

BRIDGE ELEMENT,
Krupp (Fried.) G.m.b.H., Essen (Germany, F.R.).
W. Diefendahl, and K. Koch.
U.S. Patent No. 4,355,431; October 26, 1982. 8 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1023, No 4, p 1120-1121, October 26, 1982.

Descriptors: *Patents, *Bridges, *Bridge design, *Bridge construction, *Floats, *Roads, Transportation, Constructive methods.

A floatable bridge element, having a roadway and inclining at the lower edge along one longitudinal side, bridge obstacles, especially bodies of water, and serves as a roadway. The bridge element comprises a substantially flat hollow compartment panel, the upper surface of which serves as the roadway; a rigid buoyancy body extending below and rigidly connected with the lower surface of the compartment panel; and a coupling section, connected to the compartment panel along the non-inclined longitudinal side of the bridge element and both end faces. An elevated hollow web member reinforces the bridge element and separates a walkway from the roadway. (Cremmins-AEPCO)
W88-00751

WAVE DISSIPATION CAISSON,
N. Iwasa.
U.S. Patent No. 4,431,337; February 14, 1984. 4 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1039, No 2, p 669, February 14, 1984.

Descriptors: *Patents, *Caissons, *Concrete construction, *Energy dissipation, *Breakwaters, *Piers, Wave action, Water control, Revetments, Fishing, Hydraulic permeability.

A permeable concrete caisson dissipates the energy of waves in a seabed and acts as a breakwater, revetment, pier, or fishing rock. Trapezoidal wing pieces are fixed in combination to the inside of a box-type frame formed by angled sections. The waves advancing into the frame are shifted and divided by the wing pieces. (Cremmins-AEPCO)
W88-00752

BRIDGES FOR PROVIDING ACCESS FROM A WATER-BORNE CRAFT TO THE SHORE,
J. Rose, and J. S. Pearson.
U.S. Patent No. 4,337,545; July 6, 1982. 10 p, 14 fig. Official Gazette of the United States Patent Office, Vol 1020, No 1, p 9, July 6, 1982.

Descriptors: *Patents, *Bridges, *Bridge construction, *Bridge design, *Ships, Shores, Piers, Storage.

A bridging beam consists of a ship end, a shore end and two lateral sides, for providing an access track from a shore or quay at the shore end to a water-borne craft at the ship end. The beam is supported at the shore end by a pivotal connection around a generally horizontal axis, to enable the ship end of the beam to rise and fall. A system provides for slewing the beam about a substantially vertical axis at the shore end between a stowed position and an operative position. When it is stowed, the beam is substantially received in a recess in a quay edge with a side surface of the beam substantially flush with the side surface of the quay. The bridge can be used to provide access to water-borne craft other than ships, for example hovercraft. (Cremmins-AEPCO)
W88-00754

LIGHTWEIGHT CONCRETE MARINE FLOAT AND METHOD OF CONSTRUCTING SAME,
Builders Concrete, Inc., Bellingham, WA.
W. W. Sluys.
U.S. Patent No. 4,318,361; March 9, 1982. 8 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1016, No 2, p 387-388, March 9, 1982.

Descriptors: *Patents, *Concretes, *Floats, *Construction methods, *Concrete technology, *Concrete construction, Bridges, Foaming, Bonding, Concrete mixes, Concrete additives.

A lightweight marine float comprises a volume formed by a deck of standard aggregate concrete and side walls and a bottom of foam aggregate concrete. The shell surrounds a buoyant core formed by either a void or a block of buoyant foam. The use of standard aggregate concrete for the deck provides the float with sufficient strength to withstand shocks typically imparted to it and to secure the floats to each other. The standard aggregate concrete deck is also sufficiently resistant to wear to provide a long life walking surface. The use of foam concrete aggregate for the bottom and at least part of the side walls does not detract from the strength of the float since little strength is required in these area. Since the side walls and bottom of the float are buoyant, the float is maintained in compression rather than tension. The standard aggregate concrete forming the deck preferably extends downwardly along the sides of the core for a predetermined distance to form a relatively high strength rim surrounding the deck. Reinforcing bars may be placed along the edges of the deck and a reinforced mesh may extend around the bars and through the deck, side walls, and bottom of the float. (Cremmins-AEPCO)
W88-00755

ALASKAN OFFSHORE DRILLING BASE,
Shell Oil Co., Houston, TX.
J. R. Russer.
U.S. Patent No. 4,420,275; December 13, 1983. 7 p, 9 fig. Official Gazette of the United States Patent Office, Vol 1037, No 2, p 649, December 13, 1983.

Descriptors: *Patents, *Drilling, *Offshore platforms, *Oil fields, *Erosion control, Sand, Gravel, Oil wells, Drainage systems.

An offshore drilling base for oil and gas wells in Alaska is constructed of sand and gravel. To prevent erosion of the sand and gravel island due to wave, wind, and ice action, its sloping sides are covered with a flexible material, such as polypropylene. This porous fabric is anchored in place by a later of heavy sand bags arranged in an imbricated manner between the high and low water levels on the island. Water entrapped in the interstices of the sand and gravel may drain outwardly through a fabric covering. In the event that a fabric is not used, flexible plastic sheets employed to cover the sloping sides of the island may be perforated. (Cremmins-AEPCO)
W88-00758

FLOOD WATER CONTAINMENT BAG,
American Threshold Industries, Inc., Ashville, NC.
For primary bibliographic entry see Field 4A.
W88-00760

PROCESS FOR STRENGTHENING SOFT SOIL,
Chiyoda Chemical Engineering and Construction Co. (Japan).
For primary bibliographic entry see Field 8D.
W88-00764

STABILIZATION OF PARTICULATE MATERIAL,
F. D. Cartwright.
U.S. Patent No. 4,367,984; January 11, 1983. 4 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1026, No 2, p 493-494, January 11, 1983.

Descriptors: *Patents, *Particulate matter, *Dam construction, *Permeability, *Dams, *Slope stabilization, Erosion control, Soil conservation, Dunes, Embankments.

Particulate material, particularly the surface material of mine dumps, sand dunes, and sloping earth embankments, is stabilized by providing dams on the surface, placing a liquid stabilizing medium in the dams, and allowing the liquid in the dams to permeate the surface of the material. The surface of the particulate material is loosened to a predetermined depth to facilitate permeation by the liquid stabilizing medium. If the surface of the material to be stabilized slopes, the dams are provided by embedding sheet material on edge in the material at spaced intervals across its slope. The embedded sheet material extends above the surface of the particulate materials so that the liquid stabilizing medium is damned above and below the surface of the material. (Cremmins-AEPCO)
W88-00765

SUSPENSION BRIDGE AND METHOD OF ERECTING SAME,
Habegger (Willy) A.G., Thun (Switzerland).
W. Habegger, and E. Lauber.
U.S. Patent No. 4,457,035; July 3, 1984. 12 p, 13 fig. Official Gazette of the United States Patent Office, Vol 1044, No 1, p 14-15, July 3, 1984.

Descriptors: *Patents, *Bridges, *Bridge construction, *Construction methods, *Bridge design, Suspension, Roads.

A suspension bridge, which can be carried to and erected in remote locations, contains a pair of horizontally spaced towers spanned by a main catenary cable. A flexible spacer element, normally a cable, extends along the main cable between the towers and is provided with equispaced spacers. Hanger assemblies are fixed at the spacers and can slide on the main cable between the towers. Upright hangers defining a vertical plane with the main cable have upper ends connected to the hanger assemblies and lower ends and are provided with components to shorten and lengthen the distance between ends. Girders are secured to the lower ends and extend perpendicular to the plane and path sections extend horizontally. Each section has one end hooked over one of the girders and another end hooked over an adjacent girder. The sections each have an effective length between the girders equal to the distance between the adjacent spacers of the spacer element and they together form a continuous path between the towers. (Cremmins-AEPCO)
W88-00767

SUPPORT STRUCTURE, PARTICULARLY FOR A LONG SPAN BRIDGE,
Dyckerhoff und Widmann A.G., Munich (Germany, F.R.
H. Schambeck.
U.S. Patent No. 4,589,156; May 20, 1986. 5 p, 5 fig, 2 ref. Official Gazette of the United States Patent Office, Vol 1066, No 3, p 1057, May 20, 1986.

Descriptors: *Patents, *Bridges, *Bridge construction, *Construction methods, *Concrete construction, Reinforced concrete, Bridge design, Roads, Prestressed concrete.

Diagonal compression struts for a long span bridge are suspended from the bridge roadway girder and/or the support piers by tie members or rods acting in tension. The dead load of the compression struts is conducted via the tie rods directly to the bridge structure so that downward buckling of the struts is prevented. Simple tie rods are sufficient for attachment to the struts, since upward buckling or displacement of the struts is prevented due to their dead weight. The tie rods can be adapted to both static and constructional requirements. They may be formed as reinforced concrete members, or be provided as simple steel tie rods or bars formed of individual steel elements arranged in a tubular sheathing for protection against corrosion and enclosed within the sheathing by a hardenable material, such as grout injected into the sheathing. (Cremmins-AEPCO)
W88-00768

STIFFENING GIRDER FOR A STAYED CABLE BRIDGE,
Dyckerhoff und Widmann A.G., Munich (Germany, F.R.
H. Schambeck.
U.S. Patent No. 4,513,465; April 30, 1985. 6 p, 9 fig. Official Gazette of the United States Patent Office, Vol 1053, No 5, p 1990, April 30, 1985.

Descriptors: *Patents, *Bridge construction, *Construction methods, *Bridges, *Concrete construction, Bridge design, Prestressed concrete, Reinforced concrete, Roads.

A stiffening girder for a stayed cable bridge is formed of reinforcing or prestressed concrete, and comprises a multi-cell box elongated in the long direction of the bridge and closed in that direction. A system supporting the box includes cables inclined in the elongated direction of and secured to the box. The cables are arranged in at least one upwardly extending support plane extending in the elongated direction of and upwardly from the box. The box comprises a horizontally extending continuous roadway slab forming the upper part of the box and a pair of opposite edges extending in the long direction of the box. Webs extend downwardly from the roadway slab in the long direction of the box and extend continuously along the underside of the roadway slab. The structural members forming the box-shaped cross-section extend in the long direction of the bridge and are in the form of plate members, which in the transverse cross-section of the bridge form a truss-like arrangement capable of accommodating vertical loads, or at least a certain combination of loads acting at the junction points, without requiring any additional structural elements extending in the transverse direction of the bridge. (Cremmins-AEPCO)
W88-00769

FLOATING HIGHWAY,
S. Deiana.
U.S. Patent No. 4,487,151; December 11, 1984. 11 p, 13 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1049, No 2, p 588, December 11, 1984.

Descriptors: *Patents, *Floats, *Highways, *Pontoons, Transportation, Barriers, Wave action, Bridges, Bridge design, Construction methods, Bridge construction.

A floating highway comprised of a generally rectangular horizontal pontoon includes a system for flotation of the pontoon. A centrally located horizontal tongue is progressively narrower toward its nose extending outwardly from a short side of the pontoon. The top surface of the tongue is an extension of the top surface of the pontoon. A recess in the opposite side of the pontoon has a shape for enclosing the tongue which matches the shape of the tongue. A slot extends from the top surface of the tongue across its width, and a pair of in-line slots from the top surface of the pontoon extend across at least part of the opposite side of the pontoon. The latter slots are coextensive with the slot in a tongue of another unit which may be enclosed in the recess. (Cremmins-AEPCO)
W88-00770

TRANSPORTABLE BRIDGE,
Ministry of Defence, London (England).
J. P. Fitzgerald-Smith.
U.S. Patent No. 4,411,036; October 25, 1983. 6 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1035, No 4, p 1386-1387, October 25, 1983.

Descriptors: *Patents, *Bridge construction, *Bridges, *Construction methods, Transportation, Bridge design.

A readily transported and deployed bridge spans gaps of up to about 8 m. The bridge has a contractible width for transportation and a transporter/launcher vehicle from which the bridge may be rotatably launched. The transportable bridge includes two substantially parallel trackway girders each having a decking face, a ground opposable face, a home bank end, and a far bank ends. The girders are laterally spaced apart by articulated decking member each pivotally attached adjacent their two ends to the two girders respectively so as to be foldable in a direction permitting variation of the lateral separation of the two girders. The articulated decking members may be two-part and foldable in a plane parallel with the decking faces. The members together provide a common surface which is preferably disposed at the level of the decking faces. For convenience in transit, each girder may be transversely jointed and comprise two girder portions, pivotally interconnected so as to permit relative rotation of the portions about an axis parallel to the decking face. A locking system is provided for securing the portions in longitudinal alignment in deployment. (Cremmins-AEPCO)
W88-00771

FLOATING BRIDGE,
Porsche (F.) A.G., Stuttgart (Germany, F.R.).
F. Soffge, and H. Weigele.
U.S. Patent No. 4,297,759; November 3, 1981. 8 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1012, No 1, p 11, November 3, 1981.

Descriptors: *Patents, *Bridges, *Floats, *Bridge construction, *Construction methods, *Pontoons, *Bridge design, Transportation.

A buoyant platoon and a bridge pivotably disposed on it form a floating bridge unit. A lifting and pivoting device disposed in retaining elements on the pontoon side serves to pivot the bridge. During off-loading, the bridges are first received in a rotatable fixing device and then firmly joined by a coupling device. Bridges which are disposed more or less parallel to each other can be hung at the corners using the fixing device, and can be shifted by the pivoting and lifting device into a position for frontal connection. The lifting and pivoting device includes an external housing braced on the pontoon, and a pivot mount for rotation and adjustment of height. The pivot mount has retaining elements for connection with the bridge and centrally disposed lift cylinder braced on the pontoon. The cylinder is connected with a pivot drive, which is comprised of an adjusting cylinder that engages a bracket of the pivot mount or of the lift cylinder braced on the housing. (Cremmins-AEPCO)
W88-00772

PONTOON FOR FLOATING BRIDGES AND FERRIES,
Ingenieurbuero Echtler Kaiserslauten G.m.b.H. (Germany, F.R.).
T. Echtler.
U.S. Patent No. 4,493,284; January 15, 1985. 6 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1050, No 3, p 892, January 15, 1985.

Descriptors: *Patents, *Pontoons, *Bridges, *Ferriers, *Floats, *Construction methods, Bridge construction, Floating, Transportation.

A pontoon for floating bridges and ferries consists of four unfoldable and collapsible floats. A treadway leads into at least one of the outer floats and has couplings on at least one transverse side for articulation to the outer edge of the inner floats. The treadway is constructed as a ramp part which extends over approximately the entire length of the outer floats. The width of the ramp part and the couplings to it and to the inner floats are arranged so that at least two and preferably four ramp parts are articulated adjacent to each other and to the inner floats to form a closed ramp. Ramps can be assembled from such pontoons by removing four ramp from each one. The ramps form a closed roadway and can bridge approximately the same distance as a ramp. The individual ramp parts can be adapted more easily to irregular bank slopes than a rigid ramp section can. (Cremmins-AEPCO)
W88-00773

LONG-SPAN BRIDGES,
National Maritime Inst., Feltham (England).
J. R. Richardson.
U.S. Patent No. 4,451,950; June 5, 1984. 5 p, 3 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1043, No 1, p 19 , June 5, 1984.

Descriptors: *Patents, *Bridges, *Bridge construction, *Construction methods, *Bridge design, Drag, Resistance, Wind pressure, Structural beams.

Deck instability from high winds is reduced in a long-span bridge in which the deck is supported by a span with some freedom to twist about its longitudinal axis. The bridge is composed of two or more parallel spans having independently-supported decks; each pair of spans is transversely spaced by a distance greater than the width of either deck and joined at intervals along their length by stiff transverse beams which couple the two decks so that they behave in torsion as a single substantially rigid body. The transverse beams are connected at their ends to the decks and they preferably extend under the two decks. In a suspension bridge in which each deck is suspended from its own pair of transversely-spaced cables, the transverse beams could be arranged to connect all four cables. The addition of diagonal shear bracing between the transverse beams greatly increases the horizontal bending stiffness of the bridge and thus improves the resistance to drag forces. (Cremmins-AEPCO)
W88-00774

METHOD OF ERECTING A CABLE STAYED BRIDGE,
Figg and Muller Engineers, Inc., Tallahassee, FL.
J. M. Muller.
U.S. Patent No. 4,662,019; May 5, 1987. 6 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1071, No 1, p 19, May 5, 1987.

Descriptors: *Patents, *Bridge construction, *Bridges, *Construction methods, *Bridge design, Floats, Abutments.

Approach spans are constructed over piers from a bridge abutment until the main span location at which a cable stayed deck bridge section is to be located is reached. An open gap is left in one of the approach spans at a distance from the end of the last approach span greater than half the length of the cable stayed bridge section to be constructed and a bridge pylon is temporarily supported below the gap and extends above the approach spans to the normal height required. The approach spans which adjoin opposite sides of the gap are employed as in situ work surfaces, as equal deck lengths of the cable stayed bridge section are assembled directly on the work surfaces, and the lengths are connected together by a mid-section overlying the gap. As the equal lengths are being assembled, they are supported from the pylon with cable stays and anchored to the deck lengths at spaced designated locations. The completely assembled cable stayed bridge section is then moved transversely together with its pylon and cable stays as a unit, away from and clear of the approach spans, after which it is moved as a unit to the main span location as a continuation of the last approach

span. The unit is then permanently supported by its pylon at the main span location. (Cremmins-AEPCO)
W88-00775

RESULTS OF THE CURRANT CREEK PIPELINE IMPACT LOADING STUDY, CENTRAL UTAH PROJECT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
M. C. Gemperline.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-83-16, August 1984. 86 p, 26 fig, 1 tab, 11 ref, 4 append.

Descriptors: *Dam construction, *Load distribution, *Pressure distribution, *Structural engineering, *Central Utah Project, Pipelines, Dams, Construction, Design criteria, Soil types, Soil density, Utah.

The purpose of the Impact Loading Study, which was conducted at the Red Fleet Dam construction site near Vernal, Utah, was to measure pressures exerted on a buried structure by scrapers, and use those pressures to compute impact factors. The study consisted of measuring pressures and computing impact factors for loaded construction equipment (scrapers) crossing a buried, instrumented concrete slab. Impact factors were determined experimentally under several conditions which could occur during construction operations. The two factors found to be most significant to computed impact factors were roughness of the ground surface and scraper speed. Factors found to have little influence on the computed impact factors were depth of soil covering the concrete slab and soil type. As expected, the measured pressure increased as the depth of cover decreased. Computed impact factors ranged from 1 to 3. The study results also imply that under certain conditions impact factors larger than 3 are possible. The measurement of large impact factors, under conditions not uncommon to construction sites, dictates that controls be placed on design and construction practices for structures buried near the ground surface. (Author's abstract)
W88-00778

CAPE PROVINCIAL ROADS DEVELOPMENT: CULVERTS: SELECTED PROBLEM AREAS,
Cape Provincial Administration, Rondelbosch (South Africa).
E. M. Villiers.
(1984). 142 p, 70 fig, 13 tab, 25 ref.

Descriptors: *Culverts, *Conduits, Surface drainage, Hydraulic design, Causeway, Bridge construction, Construction, South Africa, Foreign construction, Construction methods.

Because of the larger numbers of culverts in road drainage systems, and the high cost of their maintenance, it is important that their construction follow designs that maximize their efficiency. This paper addresses selected problems areas related to closed conduits (culverts) used in the disposal of surface water. The following aspects associated with closed conduits are covered: hydraulic design criteria, design approach to headwater selection, impact of excessively high afflux, design approach to buoyancy, design approach to culvert inlet and outlet transitions, design approach for dual structures, causeways, and design principles and planning of protection works. (Halterman-PTT)
W88-00792

CENTRIFUGAL MODEL TEST FOR ULTIMATE BEARING CAPACITY OF FOOTINGS ON STEEP SLOPES IN COHESIONLESS SOIL,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8D.
W88-00794

CONDITION OF CORPS OF ENGINEERS CIVIL WORKS CONCRETE STRUCTURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8F.
W88-00825

BUCK ISLAND REACH, MISSISSIPPI RIVER: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
C. R. Nickles, T. J. Pokrefke, and J. E. Glover.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-85-2, March 1985. Final Report. 53 p, 32 plates.

Descriptors: *Mississippi River, *Dikes, *Hydraulic models, Navigation, Dredging, Channels, Basket bar dikes, Spur dikes, Vane dikes, Model studies, Channel improvement.

A flood of the Mississippi River in 1973, resulted in an altered channel configuration between Memphis, Tennessee and Helena, Arkansas. To predict the effectiveness of a proposed dike system in realigning the channel, a model study was undertaken. A movable-bed model reproducing approximately 12.5 miles of the Mississippi River was used to developed plans that would improve and stabilize the altered reach of the river. The results of model manipulations indicated that the original channel alignment could be restored by rebuilding damaged dikes at Buck Island and performing limited dredging. Several other dikes in the region would help maintain low flow channel conditions. (Halterman-PTT)
W88-00827

REAERATION TESTS, ENID LAKE OUTLET WORKS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W88-00844

REAERATION AT NAVIGATION LOCKS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. C. Wilhelms.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report E-85-1, January 1985. Final Report. 31 p, 17 fig, 1 tab.

Descriptors: *Dissolved oxygen, *Locks, *Nitrogen, *Aeration, *Oxygen transfer, Water quality, Conduits, Oxygenation, Navigable rivers, Hydraulic gates, Oxygen uptake, Navigation.

Gas transfer at several Corps of Engineers navigation locks was evaluated relative to effects on downstream dissolved oxygen and nitrogen concentrations. In-lock measurements indicated that very little oxygen uptake occurred during lock filling. Measurements of dissolved oxygen in the release water indicated that, in general, lock releases improve or maintain existing downstream water quality. At some locks where the downstream bulkhead slots were open to the atmosphere, significant air entrainment occurred downstream of the emptying valve during releases. The air and water mixture and hydraulic conditions in the downstream release conduits caused significant oxygen uptake and even oxygen supersaturation. Simultaneously, nitrogen supersaturation occurred but at levels that did not appear to be detrimental to aquatic biota. (Author's abstract)
W88-00846

REVIEW OF ENVIRONMENTAL CONSEQUENCES OF WATERWAY DESIGN AND CONSTRUCTION PRACTICES AS OF 1979,
Vanderbilt Univ., Nashville, TN. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 6G.
W88-00886

8B. Hydraulics

CERTAIN EFFECTS OF FLOW AERATION IN SPILLWAYS,
For primary bibliographic entry see Field 8A.
W88-00053

CONFIGURATION OF THE PORTALS OF PRESSURE SPILLWAYS WITH GATE CHAMBERS,
S. Okunyavichyus, and A. Rimkus.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 11, p 641-646, May 1987. 3 fig, 1 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 22-25, November 1986.

Descriptors: *Intakes, *Intake gates, *Spillways, *Cavitation, *Flow velocity, *Computers, *Pressure distribution, Flow characteristics, Hydraulic design, Pressure conduits, Computer programs, Hydraulic geometry, Mathematical analysis, Closed-conduit flow, Design criteria.

Proper design of the portals of pressure spillways can reduce cavitation. The following factors must be considered: effect of the shape of the portal on its size and on the distribution of velocities and pressure over its contour, decrease of pressure behind asperities of the portal, boundary-layer formation, three-dimensionality of the flow in the inlet section, and convenience of fabrication. For portals with gate chambers, calculations performed on a computer produced a configuration which accounted for three-dimensionality as well as the other factors. Calculated pressure reduction coefficients are less than in the case of two-dimensional flow. Individual calculations using computer programs are necessary to develop the corresponding design values in each particular case. The method allows selection of portal shape without an experimental check. (Airone-PTT)
W88-00054

INVESTIGATION OF SAND RIDGES IN A LABORATORY CHANNEL FLOW,
For primary bibliographic entry see Field 2J.
W88-00055

METHOD AND APPARATUS FOR PREVENTING FOREIGN OBJECTS FROM ENTERING INTO DOCKING BASINS,
Valmet Oy, Helsinki (Finland).
For primary bibliographic entry see Field 8A.
W88-00519

CONTROL METHOD FOR OPEN CHANNEL,
Hitachi Ltd., Tokyo (Japan).
For primary bibliographic entry see Field 4A.
W88-00591

METHOD AND APPARATUS FOR CONTROLLING PRESSURE AND FLOW IN WATER DISTRIBUTION NETWORKS,
Hitachi Control Systems, Inc., Tokyo (Japan).
For primary bibliographic entry see Field 5F.
W88-00597

CAPE PROVINCIAL ROADS DEVELOPMENT: CULVERTS: SELECTED PROBLEM AREAS,
Cape Provincial Administration, Rondelbosch (South Africa).
For primary bibliographic entry see Field 8A.
W88-00792

IMPACT OF PROPOSED RUNWAY EXTENSION AT LITTLE ROCK MUNICIPAL AIRPORT ON WATER-SURFACE ELEVATIONS AND NAVIGATION CONDITIONS IN ARKANSAS RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 4C.
W88-00818

EFFECTS OF DEPTH ON DREDGING FREQUENCY, REPORT 3: EVALUATION OF ADVANCE MAINTENANCE PROJECTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. C. Berger, and J. A. Boyd.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-156635. Price codes: A03 in paper copy, A01 in microfiche. Technical Report H-78-5, April 1985. Report 3 of a Series. 43 p, 12 fig, 15 tab, 8 ref.

Descriptors: *Channels, *Hydraulic engineering, *Dredging, Sediment control, Navigation, Catchment areas, Shipyard River, South Carolina, Coos Bay, Oregon, Columbia River, Washington.

Overall costs of maintaining authorized or required project depths in the navigation channels and harbors of the United States by dredging have increased dramatically during the last decade. To reduce costs of dredging by extending the interval between maintenance dredging operations—and to provide full project dimensions for a greater period of time—advance maintenance is performed at critical shoaling areas of many navigation projects. Advance maintenance is dredging done beyond the existing authorized depth of a project to provide a predetermined amount of catchment capacity below design depth. It is exclusive of the allowable dredging tolerance (usually 1 to 2 ft) common to most dredging operations which compensates for inaccuracies inherent to the practice. The effectiveness of advance maintenance dredging was studied in six selected navigation channel segments: Shipyard River, S. C., Coos Bay, Oreg. (miles 0 to 1 and 12 to 15), and three reaches of the Columbia River, Oreg. -Wash., between miles 73 and 84. Shoaling rates and distributions and dredging frequencies resulting from maintenance operations on these projects, which included advance maintenance, were compared with data from projects not using advance maintenance. Results indicated that advance maintenance was beneficial in some, but not in all, cases and that it should be evaluated on a case-by-case basis. (Author's abstract)
W88-00822

SHIP SIMULATION STUDY OF JOHN F. BALDWIN (PHASE II) NAVIGATION CHANNEL, SAN FRANCISCO BAY, CALIFORNIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
C. Huval, B. Comes, and R. T. Garner.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-157076. Price codes: A06 in paper copy, A01 in microfiche. Technical Report HL-85-4, June 1985. Final Report. 119 p, 25 fig, 5 tab, append.

Descriptors: *Channel improvement, *Simulation analysis, *Channel morphology, *Navigation, *Model studies, *California, *San Francisco Bay, Models, Ships, Oil tankers, Deltas, Design criteria, Project planning, Bays, Harbors, Hydraulic models.

The WES Research Ship Simulator was used to evaluate the design of Phase II of the John F. Baldwin Ship Channel and to study the impact of the deepened channel on the navigability of large tankers inbound to the Long Wharf docking facility near Richmond Harbor. A reconnaissance trip was made to observe ship and pilot operations and record the inbound trip into the Long Wharf maneuvering area on a typical tanker presently using the channel. Channel geometry, overbank depths, and visual scene were then developed for the simulator using maps and photographs of the project area. Special tests were conducted on the San Francisco Bay-Delta Model to gather realistic tidal current data for input into the ship simulator. Both flood and ebb current conditions were simulated. In addition to ship track plots, several other critical parameters were plotted and studied. Results showed that it is very important to reduce tanker speed in Southampton Channel for inbound transits to about 5 knots before starting the large right turn into the maneuvering area. Acceptable docking postures can be achieved for both existing and proposed channel conditions under both ebb and flood tide so as to allow safe tanker docking into the Long Wharf. The containership tests show that it is reasonably safe to maneuver around the point and line up with the Richmond Harbor entrance channel on flood tide. Ebb tide conditions require very careful control of ship speed and position to execute a safe turn in the maneuvering area when piloting the 810-ft containership. The 638-ft containership was much easier to maneuver around the point. (Geiger-PTT)
W88-00823

BUCK ISLAND REACH, MISSISSIPPI RIVER: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W88-00827

NORFOLK HARBOR AND CHANNELS DEEPENING STUDY; REPORT 2: SEDIMENTATION INVESTIGATION, CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2L.
W88-00828

REVIEW OF NUMERICAL RESERVOIR HYDRODYNAMIC MODELING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2H.
W88-00842

GENERAL SPILLWAY INVESTIGATION: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. T. Maynord.
Technical Report HL-85-1, March 1985. Final Report. 63 p, 10 fig, 8 tab, 24 plates, 37 ref.

Descriptors: *Spillway crests, *Spillway design and construction, *Spillway crest shape, Hydraulic design criteria, Crest pressure, Discharge coefficient, Crest length, Pier contraction coefficient, Hydraulic profiles, Spillway crest slope, Flow characteristics, Flow discharge.

Previous criteria for shaping crests of spillways have a surface discontinuity at the intersection of the curved portion of the crest and the upstream face of the crest. This condition results in low pressures just downstream of the discontinuity. This work was conducted to develop a design procedure for shaping spillway crests that eliminates the surface discontinuity and that is applicable to a wide range of approach velocities and upstream face slopes. The two primary design type models that were tested were controlled crests having piers the affect flow and uncontrolled crests with no piers. Discharge coefficients, crest pressure, water surface profiles, and pier contraction coefficients were assessed for a wide range of design conditions. Results indicated that pier coefficients should be used with caution because the angle of flow approaching the spillway has a significant bearing in pier coefficients. Furthermore, pressures on the uncontrolled crests are close to atmospheric when the ratio of the energy head on crest to the design energy head on crest is equal to one. These test results provide data on conditions under which previously proposed designs can be used. (Halterman-PTT)
W88-00850

NEWBURYPORT HARBOR, MASSACHUSETTS, REPORT 2: DESIGN FOR HYDRODYNAMICS, SALINITY, AND SEDIMENTATION; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
N. J. Brogdon, and D. M. White.
Technical Report HL-79-1, March 1985. Report 2 of a Series. 554 p, 44 fig, 4 tab, 62 photos, 367 plates.

Descriptors: *Hydraulic engineering, *Shoals, *Scour, *Newburyport Harbor, *Massachusetts, Hydraulic models, Model studies, Sedimentation, Tides, Hydrodynamics, Salinity, Water currents, Flushing, Jetties, Breakwaters, Channels.

A fixed-bed model of the Newburyport Harbor and contiguous Merrimack River and Atlantic Ocean was used to study the effects of proposed improvement plans on existing hydraulic, salinity, flushing, and entrance shoaling and scouring conditions. Six plans were tested, using measurements of tidal heights, current velocities, salinities, surface current patterns, dye dispersion, and shoaling and scouring for base and proposed improvement conditions. None of the six plans would cause significant overall effects on tidal heights, salinities, or dye dispersion. However, very significant changes were noted in current patterns and magnitudes and in shoaling and scour in the entrance area and on the outer bar. None of the six plans had any significant effect on shoaling and scour rates or patterns along the beaches and offshore areas. All plans produced a general but small increase in shoaling along the eastern half of the north shoreline of Plum Island. Plans including the curved extension of the north jetty would cause increased shoaling over the inner bar and seaward end of the channel so that gains in the outer bar channel would be offset. (Cassar-PTT)
W88-00855

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 8: SUMMARY REPORT,
Coastal Engineering Research Center, Vicksburg, MS.
L. Z. Hales.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-153808. Price codes: A11 in paper copy, A01 in microfiche. Technical Report HL-80-3, January 1985. Report 8 of a Series. 226 p, 92 fig, 6 tab, 10 ref, append.

Descriptors: *Hydraulic models, *Scour, *Erosion control, *Wave action, *Tidal currents, Models, Model studies, Simulation analysis, Erosion, Coastal engineering, Water currents, Numerical analysis.

Analytical and laboratory experimental studies were carried out to develop techniques and knowledge for estimating resulting wave characteristics and wave-induced current fields in the vicinity of major coastal structures that are subject to scour during construction. Analytical developments were verified by precise experimental studies of shore-connected breakwaters. Underlayer stability studies were conducted to estimate the size of stone comprising the foundation bedding material which would remain stable under various wave conditions. A two-dimensional finite element numerical simulation model (FINITE) was developed that calculates wave heights under combined refraction and diffraction for both long and short waves approaching structures from any arbitrary direction. The wave equation solved governs the propagation of periodic, small amplitude surface gravity waves over a variable depth seabed. A computational scheme solves large practical problems. A generalized wave-induced current numerical model (CURRENT) estimates the magnitude of longshore currents and nearshore circulations in the vicinity of structures. This model was successfully applied to a complex actual prototype field situation with reasonable results. (Geiger-PTT)
W88-00856

LAKE PONTCHARTRAIN AND VICINITY HURRICANE PROTECTION PLAN, REPORT 2: PHYSICAL AND NUMERICAL MODEL INVESTIGATION OF CONTROL STRUCTURES AND THE SEABROOK LOCK; HYDRAULIC AND MATHEMATICAL MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
H. L. Butler, R. C. Berger, L. L. Daggett, and T. F. Berninghausen.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report

HL-82-2, June 1982. Report 2 of a Series. 182 p, 66 fig, 38 tab, 32 photos, 6 plates, 6 ref.

Descriptors: *Hydraulics, *Flood protection, *Hurricanes, *Louisiana, *Model studies, Hydraulic models, Lake Pontchartrain, Rigolets, Chef Menteur Pass, Canals, Finite difference models, Mathematical models, Tidal prism, Inner Harbor Navigation Canal.

The effects of the Lake Pontchartrain hurricane protection plan on the tidal prism and circulation in the lake, hurricane surge levels, and water quality were studied with a hydraulic model, concentrating on three major arteries leading into the lake; the Rigolets, Chef Menteur Pass, and the Inner Harbor Navigation Canal. Experimental data obtained from the model included water surface elevations for a range of flow rates and surface current patterns near the structures. Manning's n coefficients were determined for each structure. Computational grid sectional models were developed, calibrated to define structure representation in each sectional model, and tested for various conditions simulated in the corresponding physical model. Fine-scale numerical models were also constructed and tested. (Cassar-PTT)
W88-00857

REVERIFICATION OF THE CHESAPEAKE BAY MODEL; CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2L.
W88-00862

HYDRAULIC MODELLING,
Memorial Univ. of Newfoundland, St. John's.
For primary bibliographic entry see Field 2A.
W88-00882

8C. Hydraulic Machinery

USE OF MICROCOMPUTERS FOR LABORATORY INVESTIGATIONS OF TURBINE-GENERATOR UNITS,
V. I. Vissarionov, S. G. Belyaev, and A. I. Puzanov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 11, p 624-628, May 1987. 3 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 11-13, November 1986.

Descriptors: *Computers, *Microcomputers, *Data acquisition, *Automation, *Turbines, *Vibration, Hydroelectric powerplants, Hydraulic design, Fluctuations, Reinforced concrete, Pumping plants, Flow characteristics, Data processing.

A microcomputer-based MCC (measuring-computing complex) was developed which makes it possible directly during a physical experiment to obtain estimates of the statistical characteristics of pressure fluctuation processes in the waterway of turbine-generator unit blocks. It was tested while conducting hydrodynamic investigations of the block of a pumping station with a vertical unit. The range of investigated pressures was from 0.001 to 2.0 MPa. A block diagram of the MCC is included. The microcomputer-based MCC can be used for vibration and hydrodynamic investigations of hydraulic structures. (Airone-PTT)
W88-00051

EXPERIMENTAL INVESTIGATIONS OF ORTHOGONAL UNITS FOR USING THE ENERGY OF FLOWS,
V. M. Lyatkher, I.I. Ivanov, and S. I. Skosareva.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 11, p 652-658, May 1987. 6 fig, 2 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 33-37, November 1986.

Descriptors: *Rotors, *Impellers, *Hydroelectric power, Turbines, Hydraulic design, Water currents, Tidal energy, Hydrodynamics.

Laboratory investigations of model rotor-type impellers were conducted in a hydraulic flume (free-flow) at water flow velocities of 1-1.2 m/sec, Reynolds numbers up to 150,000, and Froude numbers considerably less than 1.0. The two-bladed, two-level units of the VTT type (blade height 0.8-1.0D, chord length of airfoil section 0.125D, degree of solidity 0.25 with an internal shaft d < or = 0.1D, profiled cross-bars, working blades and cross-bars connected into a frame construction), and the two-bladed, one-level units of VB type (cantilever attachment of the blade with a height > or = 5b and chord approximately 0.1D and without internal shaft) have the best power characteristics. The power use coefficient for such rotors reaches 50-60% at a speed ratio of 2.8-3.2. The optimum solidity of the swept area of the rotor (ib/D) is 20-30%. Examination of rotors in small hydroelectric station projects as well as in other hydropower projects is an effective way to obtain such data. (Airone-PTT)
W88-00056

TURBINE PERFORMANCE TEST, UNIT G24: GRAND COULEE DAM; GRAND COULEE THIRD POWERPLANT COLUMBIA BASIN PROJECT: FLOW MEASUREMENT BY THE PRESSURE-TIME METHOD.
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
Report No. HM-25, December 1984. 59 p, 6 fig, 12 tab, 9 append.

Descriptors: *Hydraulic machinery, *Turbines, *Electrical equipment, Grand Coulee Dam, Washington, Performance evaluation, Powerplants, Electric powerplants, Francis turbines, Efficiency, Generators.

A performance test was conducted on the vertical-shaft, Francis-type turbine (Unit G24) in the Third Powerplant at Grand Coulee Dam, Washington, on June 7-9, 1983. Maximum efficiency was 94.06% at an adjusted discharge of 29,589 cu ft/sec at a net head of 305 ft for an adjusted turbine output of 960,000 horsepower. This exceeded the design efficiency of 92.89% by 0.36%. (Cassar-PTT)
W88-00470

OFFSHORE INTAKE STRUCTURE,
For primary bibliographic entry see Field 8A.
W88-00499

BILGE SYSTEM,
Texas Oil Spill Control, Inc., Conroe.
For primary bibliographic entry see Field 5G.
W88-00513

FLEXIBLE RETRACTABLE COLD WATER PIPE FOR AN OCEAN THERMAL ENERGY CONVERSION SYSTEM,
Lockheed Missiles and Space Co., Inc., Sunnyvale, CA.
For primary bibliographic entry see Field 8A.
W88-00517

COMBUSTION POWERED WAVE GENERATOR,
D. Bastenhof.
U.S. Patent No.4,515,500; May 7, 1985. 5 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1054, No 1, p 229, May 7, 1985.

Descriptors: *Patents, *Wave generators, *Swimming pools, *Wave action, *Electrical equipment, *Recreation, Caissons, Pneumatic equipment, Pressure distribution, Heating.

Artificial waves for use in swimming pools are generated by displacing water directly through a combustion process. A mixture of gas and air is injected into the space above the water level of enclosed chambers within a caisson. The combustive mixture within each chamber is selectively ignited to produce a desired wave condition to propagate over the pool surface. The wave parameters are controlled by the amount of water displaced per unit time, the choice of fuel, and the extent and velocity of combustion. The combustion process can be controlled sufficiently to maintain a clean and complete combustion such that the combustion products do not pollute the water. In addition, the wave-generating system requires no additional floor space, and is easy to control to produce the desired wave. Also, the chambers may be of smaller dimension, to produce a more silent operation than conventional pneumatic wave generators. The heat from the combustion process can be utilized for heating of the surrounding environment. (Cremmins-AEPCO)
W88-00589

FLOW DIVIDER FOR DISTRIBUTION SYSTEMS,
J. E. Tyson.
U.S. Patent No. 4,605,501; August 12, 1986. 4 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1069, No 2, p 751, August 12, 1986.

Descriptors: *Patents, *Wastewater treatment, *Septic tanks, *Effluents, *Flow regulators, Construction joints, Flow control, Distribution.

A distribution joint for septic tanks divides the effluent flow and prevents the buildup of solids on the flow divider. A relatively steep knife edge is provided beginning at an overhanging lip and extending downward to a second angular knife edge at the lower end. Since the overhanging lip is adjacent to the divider knife edge, even a small, slow flow, as it drops off the lip, will increase in speed thus preventing particle lodging and buildup. Also, any buildup that does occur on the knife edge will eventually be washed by the heavier flows down the knife edge, and it will be cut by the second or angular knife edge and washed to either side from continued heavy flow pressure. (Cremmins-AEPCO)
W88-00595

WATERSTOP FOR MONOLITH JOINTS,
Gelco Grouting Service, Salem, OR.
For primary bibliographic entry see Field 8A.
W88-00618

VALUE OF ELECTRIC POWER AND POSSIBLE EFFECTS OF WEATHER MODIFICATION ON SMALL-SCALE HYDROELECTRIC PRODUCTION IN COLORADO,
Colorado Dept. of Natural Resources, Denver.
For primary bibliographic entry see Field 3B.
W88-00783

REAERATION THROUGH GATED-CONDUIT OUTLET WORKS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. C. Wilhelms, and D. R. Smith.
Technical Report E-81-5, March 1981. Final Report. 78 p, 10 fig, 38 plates, 9 ref, 3 append.

Descriptors: *Hydraulic structures, *Reservoirs, *Aeration, *Outlets, Temperature, Water temperature, Gates, Hydraulic gates, Energy dissipation model, Deficit ration model, Model studies, Dissolved oxygen, Oxygen Dams, Water quality, Conduits.

Dissolved oxygen and temperature data from twelve reservoir projects were analyzed to study aeration at the outlets, all of which were similar gated-conduit structures. Two models were used: the energy dissipation model (EDM) and the deficit ratio model (DRM). The EDM appeared more appropriate for this problem than did the DRM. Releases in all the projects studied were aerated to about 90% of saturation. Observed dissolved oxygen concentrations were in the range of 6-12 mg/L, well above the standard of 5 mg/L set by some states. (Cassar-PTT)
W88-00814

BLUE WATER DITCH PUMPING STATION, EAST ST. LOUIS, ILLINOIS: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. T. Maynord.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-119311. Price codes: A05 in paper copy, A01 in microfiche. Technical Report HL-82-13, June 1982. Final Report. 88 p, 8 fig, 18 tab, 11 photos, 24 plates, 14 ref.

Descriptors: *Hydraulic machinery, *Pumping plants, *Illinois, *Sumps, Flow distribution, Model studies, Blue Waters Ditch, Vortices, Hydraulic models.

A model study of the Blue Waters Ditch pumping station was conducted to develop a sump design which was free of adverse flow distribution, excessive circulation, and air-entraining vortices. Operation of the model with the original design sump resulted in severe vortices for many of the anticipated operating conditions because the opening in the divider wall allows substantial crossflow between pump bays. Also, the relatively large distance between the pump bell and the backwall permitted substantial circulation of flow in the original design sump. A continuous divider wall and a 0.5-ft spacing between the pump bell and the backwall resulted in substantial improvement of flow conditions at the pump intakes. However, the 90-degree change in flow direction that occurs just upstream of the sump resulted in an adverse distribution of flow approaching the pump intakes. Many modifications were tested to redistribute the approaching flow. Only converging sidewalls in conjunction with the continuous divider wall and the 0.5-ft spacing between the pump bell and the backwall were considered acceptable modifications to improve flow conditions significantly. Most modifications of the approach to the sump were ineffective because of the many possible combinations of flow direction that may enter the sump. Performance was investigated with velocities higher than the appropriately scaled Froudian velocities. (Author's abstract)
W88-00859

POINTE COUPEE PUMPING STATION SIPHON, UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. R. Copeland.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-120159. Price codes: A04 in paper copy, A01 in microfiche. Technical Report HL-82-21, September 1982. Final Report. 56 p, 14 fig, 9 tab, 6 photos, 9 plates, 15 ref.

Descriptors: *Hydraulic machinery, *Siphons, *Pumping plants, Pointe Coupee, Louisiana, Reservoirs, Hydraulic structures, Model studies.

Hydraulic models were used to evaluate the hydraulic performance of the Pointe Coupee pumping station siphon. A trap design was developed to ensure maintenance of the priming seal and to prevent excessive negative pressures at the siphon crown. The diameter of the siphon was reduced to obtain adequate priming velocities. Use of deflectors to induce priming was also tested. Pressure fluctuations and head losses were measured in the model. Pressure fluctuations and head losses were measured in the model. Scale effects inherent to siphon modeling are discussed. The recommended design siphon operated satisfactorily for the entire range of expected tailwaters and discharges. (Author's abstract)
W88-00861

TECHNIQUES FOR REAERATION OF HYDROPOWER RELEASES,
Tennessee Valley Authority, Knoxville. Div. of Water Resources.
For primary bibliographic entry see Field 6G.
W88-00887

8D. Soil Mechanics

TECHNIQUE TO EVALUATE RISK OF EMERGENCY SPILLWAY CHANNEL EROSION,
For primary bibliographic entry see Field 8A.
W88-00072

EVALUATION OF UNDERDRAINAGE TECHNIQUES FOR THE DENSIFICATION OF FINE-GRAINED DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
D. P. Hammer.
Technical Report EL-81-3, March 1981. Final Report. 103 p, 83 fig, 11 tab, 9 ref.

Descriptors: *Subsurface drainage, *Compaction, *Soil density, *Seepage, *Dredged material, *Dewatering, Evaluation, Density, Gravity filters, Vacuum filtration.

This report describes the results of a large-scale field experiment to evaluate the dewatering/densifying of fine-grained dredged material, with underdrainage techniques. The techniques evaluated were: gravity underdrainage, partial vacuum in an underdrainage layer, seepage consolidation, and seepage consolidation with a partial vacuum in the underdrainage layer. The experiment was conducted using five test sections having 30- by 30-ft bottom areas and 1V on 2H sideslopes. One section was used for each of the four techniques evaluated and one section was not treated. The untreated or control section provided a basis against which the effectiveness of the techniques evaluated could be measured. Settlement, pore pressure, water content, and vane shear measurements were taken to provide a basis of evaluation. Initially, a 6-ft nominal thickness lift of dredged material was used; then, after one year, a second 6-ft lift was added. The experiment ran for a total of approximately two years. All of the techniques evaluated produced more densification than did the test section containing untreated material. Of the techniques evaluated the partial vacuum in an underdrainage layer was the most effective. This was true with both lifts of dredged material tested but was considerable more pronounced with the first lift than the second. (Author's abstract)
W88-00464

METHOD AND APPARATUS FOR INSTALLING GROUNDWATER BARRIER,
Stevin Construction Inc., Dover, DE.
For primary bibliographic entry see Field 4B.
W88-00573

REVETMENT FOR PROTECTING THE INCLINED SURFACES OF BEACHES, SHORES, RIVERS OR CHANNELS, AND OF STRUCTURES SUCH AS MOLES, DIKES, OR CHANNEL WALLS, LOCATED IN THESE PLACES, AGAINST EROSION BY WAVES AND FLOWING WATER,
P. N. Knudsen.
U.S. Patent No. 4,465,398; August 14, 1984. 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1045, No 2, p 687, August 14, 1984.

Descriptors: *Patents, *Slope protection, *Bank protection, *Shore protection, *Erosion control, *Wave action, *Embankments, *Revetments, *Breakwaters, Rivers, Beach erosion, Channel erosion, Soil stability, Dikes, Channel improvement, Flow discharge, Shores.

The inclined surfaces of beaches, shores, rivers or channels, moles, and dikes or channel walls are protected against erosion by waves and flowing water by a revetment formed by heavy, relatively thick plate bodies located side by side and preferably directly on the inclined surface. The revetment is water-permeable, coherent, appropriately heavy, flexible, and easy to mount. Each plate body at a first pair of opposite ends comprises hinge members such as hinge pins to flexibly secure the plate body to adjacent plate bodies. Each plate body also comprises substantially vertical water penetrating holes as well as two hinge openings located at opposite ends of the body. The hinge openings are shaped in such a manner that beyond allowing water penetration they may also receive hinge pins on the adjacent plate bodies. (Cremmins-AEPCO)
W88-00605

UNINHIBITED BENTONITE COMPOSITION,
American Colloid Co., Skokie, IL.
For primary bibliographic entry see Field 4B.
W88-00620

PROCESS FOR STRENGTHENING SOFT SOIL,
Chiyoda Chemical Engineering and Construction Co. (Japan).
H. Miyoshi, E. Asanagi, and O. Terashima.
U.S. Patent No. 4,465,518; August 14, 1984. 6 p, 4 tab. Official Gazette of the United States Patent Office, Vol 1045, No 2, p 727-728, August 14, 1984.

Descriptors: *Patents, *Soil strength, *Saturated soils, *Soil stability, *Soil water, *Waste recovery, Soil saturation, Soil engineering, Soil management, Soil properties, Excess water, Industrial wastes, Portland cements, Sulfuric acid, Calcium, Gypsum.

Water saturated soft soil is strengthened by admixing it with a finely divided, non-crystalline, calcium-containing iron blast furnace slag. The slag is treated with an aqueous solution containing 20-500 g sulfuric acid per 1 kg of slag. Part of the calcium content of the slag is converted to gypsum. The treated slag and the soft soil are then admixed with a Portland cement to obtain an unconfined compressive strength of the soil greater than that obtained by using comparable amounts of cement, calcium sulfate, and unacidified slag. (Cremmins-AEPCO)
W88-00764

CENTRIFUGAL MODEL TEST FOR ULTIMATE BEARING CAPACITY OF FOOTINGS ON STEEP SLOPES IN COHESIONLESS SOIL,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
M. C. Gemperline.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-213437. Price codes: A06 in paper copy, A01 in microfiche. Report REC-ERC-84-16, June 1984. 117 p, 38 fig, 5 tab, 31 ref, 5 append.

Descriptors: *Slope stability, *Models, *Model studies, *Theoretical analysis, *Bridge construction, Soil stability, Mathematical studies, Slopes, Simulation analysis, Simulation, Mathematical models, Bridges, Bridge design, Bridge failure.

Analytical methods that are frequently used to predict the ultimate bearing capacities for shallow spread foundations on slopes yield widely varying solutions. As a result, the allowable foundation bearing pressure used for design are selected conservatively. This leads to the construction of shallow spread foundations that may be larger and more costly than necessary. To address this situation, the Bureau conducted a research program to evaluate the state of the art as it pertains to predicting the ultimate bearing capacity of shallow spread foundations located on or near slopes. This study consisted of developing and testing a technique for centrifugal modeling of shallow spread footings located on or near slopes; experimentally determining the maximum bearing pressure of four prototype shallow spread footings using scaled models; and comparing test results with state-of-the-art analytical solutions. Test equipment was fabricated to permit model footings to be loaded and their response to be measured at accelerations 100 times that of gravity. The model test results were compared with the results of theoretical solutions obtained using limit analysis, limit equilibrium analyses, a semiempirical method, and methods incorporating slip-line solutions. (Author's abstract)
W88-00794

PROCEDURES FOR PREDICTION OF CONSOLIDATION IN SOFT FINE-GRAINED DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
K. W. Cargill.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-125320. Price codes: A08 in paper copy, A01 in microfiche. Technical Report D-83-1, January 1983. Final Report. 152 p, 38 fig, 2 tab, 19 ref, 6 append.

Descriptors: *Soil mechanics, *Dredging, *Spoil banks, Model studies, Finite strain theory, Soil consolidation, Sediments, Computer programs.

Procedures for calculation of one-dimensional consolidation behavior of very soft fine-grained dredged material were studied by considering both the conventional small strain theory of consolidation and the more general finite strain theory. A procedure for calculating consolidation of multiple lifts of material placed on prior lifts of underconsolidated material was also proposed and validated. In field studies good agreement was obtained between predictions and measurements when the finite strain theory and the proposed solution technique were used. In all cases, the finite strain theory solutions were far more accurate than small strain theory solutions. The calculation is also applicable to a single lift subjected to multiple surcharge loadings as occurs in phased construction. (Cassar-PTT)
W88-00838

8E. Rock Mechanics and Geology

FROM FIELD DATA TO FRACTURE NETWORK MODELING: AN EXAMPLE INCORPORATING SPATIAL STRUCTURE,
Lawrence Berkeley Lab., CA. Earth Sciences Div.
For primary bibliographic entry see Field 2F.
W88-00032

CRITICAL DISPLACEMENT VELOCITY OF A ROCK MASS WITH RESPECT TO CRACKING DURING BLASTING,
For primary bibliographic entry see Field 8H.
W88-00052

EFFECT OF THE ACCURACY OF DETERMINING THE CHARACTERISTICS OF A ROCK MASS ON CALCULATIONS OF TUNNEL LININGS,
For primary bibliographic entry see Field 8A.
W88-00057

8F. Concrete

CONCRETE TEMPERATURE CONTROL STUDY FOR THE OLD RIVER AUXILIARY STRUCTURE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
A. A. Bombich.
Miscellaneous Paper SL-82-18, September 1982. Final Report. 42 p, 14 fig, 6 ref.

Descriptors: *Concrete technology, *Thermal cracking, *Concrete dams, *Old River Auxiliary Structure, Cracks, Mechanical failure, Computer models, Model studies, Finite-element methods, Strain, Temperature effects, Heat of hydration, Fly ash, Louisiana.

Computer simulations were made to predict temperature distribution and resulting thermal strains which are possible during construction of the Old River Auxiliary Structure on the Mississippi River. Several conclusions were reached. (1) Areas of high tensile strain were identified. These will be highly reinforced to control cracking. (2) Replacement of 25% fly ash for concrete decreased temperature rise and severity of thermal gradients but did not reduce tensile strains. (3) A cold front producing a drop in mean daily temperature of 20 F increases tensile strain up to 100% when occurring within 5 days of replacement. Daily temperature variation also increases tensile strain, but by smaller amounts. (4) The highest tensile strains occur during the initial temperature rise in the concrete. To minimize thermal cracking, the lowest possible cement contents and the largest coarse aggregate should be used in all mixtures. Maximum placement temperatures should be reduced to 70 F. The use of 6000-psi concrete should be confined to minimum areas necessary for the structural design. (Cassar-PTT)
W88-00469

EROSION CONTROL BLOCKS,
Terrafix Erosion Control Products, Inc., Islington (Ontario).
For primary bibliographic entry see Field 4D.
W88-00600

CONDITION SURVEY OF DEPERE LOCK AND DAM, LOWER FOX RIVER, WISCONSIN,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. L. Stowe, and J. C. Ahlvin.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA 119121. Price codes: X00 in paper copy, A01 in microfiche. Miscellaneous Paper SL-82-3, June 1982. Final Report. 122 p, 2 fig, 6 tab, 26 plates, 8 ref, 2 append.

Descriptors: *Concrete dams, *Concrete testing, *Testing procedures, Dams, DePere Lock and Dam, Wisconsin, Lower Fox River, Wisconsin, Condition surveys, Compression strength, Elastic moduli, Shear strength.

Detailed analyses of lock and dam structures are necessary to assess their structural integrity. The objectives of this study were to evaluate subsurface conditions, to assess the in-place concrete conditions, to ascertain selected physical properties of concrete and rock, and to evaluate this information in order to present design parameters as guidance for a structural stability analysis. This study entailed a condition survey of the DePere Lock and Dam on the Lower Fox River, Wisconsin. The field investigation included drilling for core samples of concrete, foundation rock, and backfill. Selected specimens of these materials were tested in the laboratory for certain physical and mechanical properties. Results of the field investigation and laboratory tests indicated that the concrete in the lock and dam is locally cracked and lightly deteriorated but structurally sound. Cycles of freezing and thawing have caused the concrete deterioration. The lock and dam is founded on competent bedrock. No soft or otherwise weak zones were detected in the bedrock. Soundings should be made to detect any scouring behind the dam. It is suggested that the reinforced steel in the tainter gate piers, adjacent to the hinge pins, be examined for corrosion. (Author's abstract)
W88-00683

BREAKWATER,
For primary bibliographic entry see Field 8A.
W88-00748

METHOD FOR MAKING ELONGATE CAST CONSTRUCTION ON THE SEA,
For primary bibliographic entry see Field 8A.
W88-00750

WAVE DISSIPATION CAISSON,
For primary bibliographic entry see Field 8A.
W88-00752

LIGHTWEIGHT CONCRETE MARINE FLOAT AND METHOD OF CONSTRUCTING SAME,
Builders Concrete, Inc., Bellingham, WA.
For primary bibliographic entry see Field 8A.
W88-00755

SUPPORT STRUCTURE, PARTICULARLY FOR A LONG SPAN BRIDGE,
Dyckerhoff und Widmann A.G., Munich (Germany, F.R.
For primary bibliographic entry see Field 8A.
W88-00768

STIFFENING GIRDER FOR A STAYED CABLE BRIDGE,
Dyckerhoff und Widmann A.G., Munich (Germany, F.R.
For primary bibliographic entry see Field 8A.
W88-00769

IMPLEMENTATION OF POLYMER IMPREGNATION AS A BRIDGE DECK SEALANT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. G. Smoak.
Available from the National Technical Information Service, Springfield, VA 22161, as NTN85-1217. Report REC-ERC-84-11, September 1984. 71 p, 45 fig, 9 tab, 13 ref, 2 append.

Descriptors: *Concrete, *Bridges, *Roads, *Polymers, *Sealants, Deicers, Chlorides, Freeze-thaw tests, Cracks, Acrylic polymers, Corrosion, Protection, Construction.

A process for impregnating the surface of concrete bridge decks with an acrylic monomer system was developed and evaluated for 8 years on eight bridges in widely varying locations and climates from Maine to California. Infrared radiation proved to be the most convenient and economical heating technique. Electric resistance heating blankets were also fully satisfactory. Circular pattern cracking, which appeared on the surface of all nonprestressed concrete treated with the system, was not corrected with reductions in drying time and temperature. In fact, this pattern was also observed on untreated concrete bridge decks in use for 3-5 years. Chloride intrusion tests on 40 concrete slabs (exposure to 90 days' ponding with 3% solution) showed very little chloride intrusion in the impregnated slabs compared with the untreated slabs. However, significantly higher chloride concentrations were found below the impregnated zones than in companion unimpregnated concrete. This showed that pattern cracks permit chlorides to penetrate below the zone of impregnation, resulting in greater chloride concentrations. No active reinforcing steel corrosion was attributed to the chloride penetration. Freeze-thaw and abrasion resistance were significantly improved in concrete not exposed to chlorides. The impregnation system should not be used on new uncracked concrete if the pattern shrinkage cracking is a problem. Until further information is obtained, the system should not be used on concrete exposed to chlorides. An appendix containing the most recent surface impregnation construction specifications is included. (Cassar-PTT)
W88-00779

CONDITION OF CORPS OF ENGINEERS CIVIL WORKS CONCRETE STRUCTURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
J. E. McDonald, and R. L. Campbell.
Technical Report REMR-CS-2, April 1985. Final Report. 140 p, 23 fig, 23 tab, 3 append.

Descriptors: *Concrete, *Hydraulic structures, *Dams, *Locks, Maintenance, Bridges, Damage, Seepage, Spalling, Cracks.

Information on the condition of Corps of Engineers' concrete structures was collected and analyzed, using 2000 inspection reports of 766 projects. The number of severe deficiencies was correlated with age of the structure. Concrete cracking was the deficiency most often observed (3842 observations) accounting for 38% of the total deficiencies. Other major problems were seepage and spalling, 20% and 19%, respectively, of the total deficiencies. The causes of the deficiencies were apparent in only 17% of the deficiencies. More than 60% of total deficiencies were located in dams compared to 22% in navigation locks, partly because the system has twice as many dams

as locks. In dams 96% of the deficiencies were not severe or structurally threatening; maintenance activities can control most of these problems. However, the proportion of severe deficiencies was greater in the navigation locks; this requires a repair and rehabilitation program in addition to regular maintenance. Repair and maintenance materials were rated satisfactory for only half of repairs, necessitating improvement in selection and application of repair materials. (Cassar-PTT)
W88-00825

DURABILITY AND BEHAVIOR OF PRESTRESSED CONCRETE BEAMS; REPORT 6: POSTTENSIONED CONCRETE BEAM INVESTIGATION, SUPPLEMENTAL LABORATORY TESTS OF BEAMS EXPOSED FROM 1961-1982,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
E. F. O'Neil, and G. L. Odom.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-148821. Price codes: A03 in paper copy, A01 in microfiche. Technical Report 6-570, October 1984. Report 6 of a Series. 40 p, 5 fig, 5 tab, 22 photos, 6 ref.

Descriptors: *Concrete testing, *Weathering, *Erosion, Posttensioning, Epoxy resins, Construction joints, Prestressed concrete.

The sixth report in a series describing studies on the durability of air-entrained, prestressed concrete beams is concerned with field and laboratory testing and with observation of posttensioning systems (4 types) including end anchorages (12 types), end anchorage protection, posttensioning conduit, and posttensioning wires. Six types of joint preparation were used; three types of end protections were used. Testing on three beams returned from the exposure station at Treat Island, Maine, were studied in detail. The conventional reinforcing stirrups were only lightly corroded, <10% of the total surface area. Most of this rust occurred at the spot where the stirrups were welded to each other and to the longitudinal reinforcement. Likewise, little rust was observed on the outsides of the metal conduits. Each wire of each beam was rusted to some degree. Thermal expansion existed between the epoxy concrete end cap and the concrete beam. The difference in expansion between the seaward end cap and the concrete beam was greater than the difference in expansion for the landward end cap and the concrete beam. This was caused by the deterioration which had occurred on the seaward end. The major factor contributing to the joint deterioration was the difference in thermal expansion between the two materials; a secondary factor was freezing and thawing of the portland cement concrete. (Cassar-PTT)
W88-00851

CEMENT COMPOSITION AND CONCRETE DURABILITY IN SEA WATER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
A. D. Buck, K. Mather, and B. Mather.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-152288. Price codes: A04 in paper copy, A01 in microfiche. Technical Report SL-84-21, December 1984. Final Report. 67 p, 2 fig, 9 tab, 6 inclosures, 6 ref.

Descriptors: *Cements, *Concretes, *Concrete testing, *Concrete technology, Pozzolans, Concrete mixes, Mortar.

The effects of cement composition on durability of concrete in sea water were investigated. The separate and combined effects of alkali-silica reaction and sulfate attack were evaluated both in the laboratory and using concrete specimens from 16 mixtures exposed in warm sea water at St. Augustine, Florida. Three mixtures were made that were susceptible to both alkali-silica reaction and sulfate attack, three that should not manifest either reaction, three susceptible to alkali-silica reaction only, and seven susceptible to sulfate attack only. Performance of specimens in the field plus some laboratory tests indicated these intents were generally successful. A major finding from this work was that the combined effects of both reactions caused quicker and more complete destruction of concrete and mortar than either reaction alone. While one would intuitively guess this would be the case, this work provided proof of this for the first time, so far as is known. Another result was to confirm that the mitigating effects of a pozzolan are optimized when the proper amount of pozzolan is used. This work also showed more alkali-silica reaction due to high potassium levels than to high sodium levels. (Author's abstract)
W88-00863

8G. Materials

MEASUREMENTS AND CONTROL RELATED TO CORROSION AND SCALE IN WATER DESALINATION INSTALLATIONS,
Dow Chemical Co., Freeport, TX.
For primary bibliographic entry see Field 3A.
W88-00090

METHOD OF PROVIDING EARTH COVERING USEFUL FOR WATER HARVESTING,
Dow Corning Corp., Midland, MI.
For primary bibliographic entry see Field 3B.
W88-00521

SYSTEM FOR DETECTING LEAKS FROM LIQUID-CONTAINING RESERVOIRS AND CONDUITS,
For primary bibliographic entry see Field 5E.
W88-00601

RESULTS OF THE CURRANT CREEK PIPELINE IMPACT LOADING STUDY, CENTRAL UTAH PROJECT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8A.
W88-00778

EROSION STUDIES OF PIPE LINING MATERIALS: FIFTH PROGRESS REPORT,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
H. Johns.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85-174282. Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-84-3, May 1984. 47 p, 36 fig, 12 tab, 7 ref.

Descriptors: *Materials testing, *Pipes, *Linings, *Polymers, *Erosion, Plastics, Polyethylene, Rubber, Polyvinyl chloride, Coal tar enamel, Polyester resins, Resins, Protective coatings, Coatings, Mortar, Steel pipes.

Erosion resistance of water pipe linings has been evaluated using a sand-water or gravel-water slurry. Coal tar enamel, which has good erosion resistance, is used as the standard of comparison. Materials with better erosion resistance than coal-tar enamel are as follows: 17 reinforced plastic mortar liners, concrete, steel, synthetic and natural rubber sheet, polyvinyl chloride, polyethylene, and acrylonitrile butadiene styrene (ABS). Less resistant materials are four of the reinforced plastic mortar liners, three reinforced thermosetting pipe liners, and one vinyl resin liner for asbestos-cement pipe. Sheet rubber liners are the most erosion resistant. All the thermoplastic pipes (polyvinyl chloride, ABS, and polyethylene) are more resistant than coal tar enamel, up to ratios of 10 to 1. (Cassar-PTT)
W88-00780

8H. Rapid Excavation

CRITICAL DISPLACEMENT VELOCITY OF A ROCK MASS WITH RESPECT TO CRACKING DURING BLASTING,
M. I. Shuifer, and A. E. Azarkovich.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 11, p 628-633, May 1987. 5 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 13-17, November 1986.

Descriptors: *Rapid excavation, *Boreholes, *Blasting, Critical velocity, Rock mechanics, Rock excavation, Wave propagation, Explosives, Strength.

On the basis of analysis of the experimental data and examination of the factors influencing the critical displacement velocity, an analytical method is proposed for determining the critical displacement velocity during blasting in rock masses composed of various rocks and with various natural jointing. The critical displacement velocity can serve as a basis for determining the boundaries of the zones of disturbance of rock masses by the effect of a blast. The experimental data were obtained in the blasting of wellhole charges with a diameter of 80-150 mm under on-site conditions at various construction projects in 18 varieties of rock masses. Critical velocity was established by measuring on the ground surface and at internal points of the mass the displacement in sections near the boundary of the cracking zone during blasting. (Airone-PTT)
W88-00052

METHOD AND APPARATUS FOR IMPEDING SEDIMENT DEPOSITION IN HARBORS AND NAVIGATION CHANNELS,
California Univ., Berkeley. Regents.
S. A. Jenkins, and J. B. Sparks.
U.S. Patent No. 4,560,304; December 24, 1985.. 9 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1061, No 4, p 1601-1602, December 24, 1985.

Descriptors: *Patents, *Sediment control, *Sedimentation control, *Scour, *Harbors, *Channel improvement, Sediments, Water depth, Deposition, Navigation obstructions, Delta wings, Airfoils, Suspended sediments, Suspension, Salt rejection, Mud, Water pollution control.

Water depth is maintained in harbors and navigation channels by passively resuspending sediments transported to the waterways by natural currents. A buoyant high aspect ratio delta wing having an inverted airfoil shape for producing a downward lift force is anchored at a negative angle of attack adjacent to the bottom of a waterway having a current. The net vertical deflection and turbulent trailing wake generated as the water flows past the wing prevents sediments from deposition on the bottom of the waterway for a predetermined distance downstream of the wing. Cascading arrays of such wings may be anchored in succession along the waterway to resuspend sediments and thereby maintain sufficient water depth for navigation. The method also has applications in impeding salt wedge intrusion into waterways, preventing mud from clogging intakes, and reducing water pollution. (Cremmins-AEPCO)
W88-00586

8I. Fisheries Engineering

CONTRIBUTION OF ESTUARIES TO COMMERCIAL FISHERIES IN TEMPERATE WESTERN AUSTRALIA AND THE CONCEPT OF ESTUARINE DEPENDENCE,
Western Australian Marine Research Labs., Perth.
For primary bibliographic entry see Field 2L.
W88-00136

NATURAL VS. MANMADE BACKWATERS AS NATIVE FISH HABITAT,
Yellowstone National Park, WY.
R. A. Valdez, and E. J. Wick.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 519-536, 6 fig, 8 tab, 7 ref.

Descriptors: *Fish management, *Backwater, *Rivers, *Aquatic habitats, *Aquatic life, Colorado River, Habitats, Squawfish, Humpback chub,

Sucker, Razorback sucker, Chubs, Shallow water, Dikes, Dams, Yampa River, Gravel pits.

Natural backwaters and embayments are important habitats for native fishes of the Upper Colorado River system. The protected Colorado squawfish, humpback chub and razorback sucker use these quiet areas. Water developments in the system have prompted mitigation for habitat enhancement to favor and recover these species. This paper explores the feasibility of recreating backwaters and embayments as part of this enhancement. Side channels diked for flood control in the Yampa River demonstrate the feasibility of recreating backwater using existing riverine features. These function as natural backwaters which adult Colorado squawfish occupy during runoff. They drain with descending flow and do not become refuges for predaceous and competitive non-native fishes. Natural embayments are important low-water habitats, especially for young Colorado squawfish and humpback chub after runoff. These are created naturally during high flows by eddies around channel obstructions or stable shoreline features and can be artificially created with appropriately placed wing dams and band reinforcements. Abandoned gravel pits flooded by the river have long been viewed as simulating backwaters for native fish habitat. Most contain water year around and are refuges for competitive non-native fishes and pathogens. They do not appear to benefit native species and should be sealed from the river and managed as warm-water game fisheries and waterfowl sanctuaries. However, gravel pits constructed in midchannel islands, graded gently to flood during runoff and drain with descending flow, may benefit native fishes while preventing establishment of permanent populations of non-natives. (See also W86-02484) (Author's abstract)
W88-00363

EFFECT OF HABITAT ALTERATION BY ENERGY RESOURCE DEVELOPMENTS IN THE UPPER COLORADO RIVER BASIN ON ENDANGERED FISHES,
Fish and Wildlife Service, Salt Lake City, UT.
T. J. Hickman.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 537-550, 2 tab, 20 ref.

Descriptors: *Fish management, *Environmental effects, *Rivers, *Aquatic habitats, *Reservoirs, Habitats, Colorado River, Dace, Kendall Warm Springs dace, Squawfish, Humpback chub, Chubs, Bonytail chubs, Dams, Water quality, Flow rates, Water use, Irrigation, Water demand, Energy.

The upper Colorado River system is the habitat of several endangered fish: Kendall Warm Springs dace, Colorado squawfish, humpback chub, and bonytail chub. The single most important factor contributing to the decline of these species has been the construction and operation of dams and reservoirs, which have effected flow, temperature, chemistry, biota, and migration routes. Water depletion amounting to about 25% of the total has also had similar effects, particularly by eliminating the backwater nursery areas. A predicted decrease in agricultural use and increase in energy development use would decrease the amount of used irrigation water percolating back into the groundwater and streams. In addition, water allocated for irrigation is not always used, whereas energy use would be more uniform. In order to preserve the endangered fish, cooperation between diverse groups is needed. This may require that some dam projects may be abandoned and that others may be changed or delayed. Reducing demands on the river's water supply can also aid in protecting the fish. This could take the form of energy alternatives (solar), water conservation, technological improvements, use of groundwater where feasible, and weather modification. Other habitat preservation activities are purchase of water rights, habitat manipulation and construction, fish passageways, and artificial propagation. (See also W86-02484) (Cassar-PTT)
W88-00364

ARTIFICIAL WIND POWERED CIRCULATION OF HIGH MOUNTAIN LAKES OF THE UINTAS,
Wasatch-Cache National Forest, Salt Lake City, UT.
M. A. Shaw.
IN: Aquatic Resources Management of the Colorado River Ecosystem: Proceedings of the 1981 Symposium on the Aquatic Resources Management of the Colorado River Ecosystem, November 16-18, 1981, Las Vegas, NV. Ann Arbor Science, Ann Arbor, MI. 1983. p 579-595, 12 fig, 1 tab, 2 ref.

Descriptors: *Water quality control, *Fish management, *Lakes, *Oxygen, *Water circulation, *Mountain lakes, Stratification, Thermal stratification, Dissolved oxygen, Uinta Mountains, Utah, Destratification, Temperature, Water temperature, Marsh Lake, Sargent Lake.

A wind-powered water circulator was used in three thermally stratified mountain lakes to increase dissolved oxygen levels for fish management. Marsh Lake showed a significant change in summer temperature but little change in dissolved oxygen profile; reduction of the aquatic vegetation by lowering the lake level allowed a fish population to overwinter in this lake, 33 acres with an average depth of 5.1 meters. In Sargent Lake, 9 acres in area and 4.3 meters average depth, and in Teapot Lake, 14 acres in area and 7.3 meters average depth, little effect on the oxygen-temperature profile was observed and no fish life was seen. However, the winter dissolved oxygen level was higher after the first summer of circulation. The oxygenation that occurred in Marsh Lake was attributed to better orientation to the prevailing wind. (See also W86-02484) (Cassar-PTT)
W88-00367

HABITAT SUITABILITY INDEX MODELS: GULF MENHADEN,
Gulf Coast Research Lab., Ocean Springs, MS.
For primary bibliographic entry see Field 2L.
W88-00641

GUIDANCE MANUAL FOR THE INPUT OF BIOLOGICAL INFORMATION TO WATER-INTAKE-STRUCTURE DESIGN,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 6G.
W88-00643

HYDROACOUSTIC BIOMASS ESTIMATION TECHNIQUES,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 7B.
W88-00654

FACTORS AFFECTING FISH PRODUCTION AND FISHING QUALITY IN NEW RESERVOIRS, WITH GUIDANCE ON TIMER CLEARING, BASIN PREPARATION, AND FILLING,
Fish and Wildlife Service, Fayetteville, AR.
G. R. Ploskey.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-103428. Price codes: A04 in paper copy, A01 in microfiche. Technical Report E-81-11, August 1981. Final Report. U. S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experimental Station, Vicksburg, MS. 68 p, 2 tab, 144 ref. Contract No. Intra Army WESRF-80-210.

Descriptors: *Fish management, *Reservoirs, Literature review, Reservoir fisheries, Fishing, Recreation, Forest management, Aquatic life, Invertebrates, Fish food organisms, Productivity, Bacteria, Algae, Zooplankton, Nutrients, Organic matter, Detritus, Vegetation, Flooding, Spawning.

Literature on fishery development in new reservoirs is reviewed. Many filling and site preparation techniques are available to enhance fish production and angling quality. For the first 5-10 years after filling, production is high. After nutrients and detrius from the inundated land has been used, fish production declines as the reservoir ages. Filling a reservoir in stages imitating spring flooding can increase fish production. Water temperature at the time of filling is also a consideration. When reservoirs are filled at water temperatures of 11 C, warmwater fish communities benefit. When reservoirs are filled at water temperatures of 5 C, coolwater fish communities benefit. Stage filling (filling to well defined successive pool levels) is effective in increasing fish production. However, this technique is not always practical where consumptive needs exceed the amount of water that can be supplied. Reservoir clearing plans must consider trade-offs among mosquito control, water quality, recreation, and fish production. The best reservoir clearing plans are those which retain all herbaceous plants and forest litter and timber in selected sites such as covers, embayments, old creek channels, in blocks, or in clusters. However, submerged timber may be a navigation hazard. In prairie land artificial structures may be justified to improve sport fishing. (Cassar-PTT)
W88-00864

FISHERIES OF THE UNITED STATES, 1984,
National Fishery Statistics Program, Washington, DC.
For primary bibliographic entry see Field 7C.
W88-00873

8-INCH LENGTH LIMIT IN SMALLMOUTH BASS: EFFECTS ON THE SPORT FISHERIES AND POPULATIONS ON SMALLMOUTH BASS AND YELLOW PERCH IN NEBISH LAKE, WISCONSIN,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 6G.
W88-00874

EFFECTS OF RESERVOIR WATER LEVELS ON YEAR-CLASS DEVELOPMENT AND THE ABUNDANCE OF HARVESTABLE FISH,
Aquatic Ecosystem Analysts, Fayetteville, AR.
For primary bibliographic entry see Field 6G.
W88-00889

INTRODUCTION TO CARP FARMING (INLEIDING TOT KARPBOERDERY),
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
E. J. Kruger.
The Nature Conservation Tranvaal Provincial Administration (Pretoria), No. ISBN 0 7991 0099 4, 1-53, 1975. 12 Illus, 11 fig, 6 tab, 21 ref.

Descriptors: *Fish farming, *Aquaculture, *Farm management, Fish, Water quality, Fish ponds, Fertilizers, Fish foods, Marketing, Economic evaluation, Design criteria, Fish harvest, Carp, Silver carp, Hypophthalmichthys molitrix, Tilapia aurea.

The guide strives to serve as an introduction to carp farming and as a stimulation for further self study. The methods and techniques cited are not unique to South Africa but are practiced universally. Site evaluation, the layout and construction of a carp farm, preparation of ponds, production of table fish, the marketing of fish and economic considerations are aspects discussed. (SAWIC)
W88-00944

9. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

CALIFORNIA WATER RESOURCES CENTER ANNUAL REPORT, JULY 1, 1982 - SEPTEMBER 30, 1983.
California Univ., Davis. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-201109/AS. Price codes: A06 in paper copy, A01 in microfiche. Report No. 57 (Annual Report), December

1983. 102 p.

Descriptors: *Water Research Institutes, *Education, *Training, *Research facilities, *Project planning, *Research priorities, *Institutional constraints, Acid rain, Economic aspects, Hydraulics, Climatology, Weather, Institutions, Water management, Resources management, Aquatic environment.

The Water Resources Center of the University of California is a multicampus research unit whose programs are funded from state and federal sources. The report lists the seven University of California campuses and describes the research projects funded at each. Two major program divisions are saline water conversion research and freshwater research. During this reporting year, a total of $304,529 was allocated to freshwater research projects, providing total support for 22 new and continuing projects on seven campuses and partial support for an additional four projects. The saline water program received $200,461, which was allocated to thirteen projects on two campuses. Fund allocations to research projects are made after review by the center's coordinating board. An annual call for project suggestions initiates the research program cycle. For this reporting year, a total of 58 suggestion sheets from 54 investigators were submitted to the center for review. Of these 58, 25 resulted in formal proposals being submitted, of which eleven new projects received funding. Projects currently funded include hydrology, climatology, and hydraulics; aquatic environments and ecosystems; water quality; water development and management alternatives and institutional arrangements. The center publishes and disseminates research through publications, conferences and information activities such as computerized information retrieval from federal files. (Hawkins-Omniplan)
W88-00542

ANNUAL REPORT, COLORADO WATER RESOURCES RESEARCH INSTITUTE, FY1984-1985,
Colorado State Univ., Fort Collins. Water Resources Research Inst.
N. A. Evans.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-195632/AS. Price codes: A03 in paper copy, A01 in microfiche. Institute Annual Report, (1985). 30 p. Project No. USGS G895. Contract No. 14-08-0001-G895.

Descriptors: *Research, *Information transfer, *Training, *Colorado, *Water resources institutes, Groundwater recharge, Geochemistry, Recharge wells, Wildlife habitats, Legal aspects, Institutional constraints, Reservoir releases, Flow control, Evapotranspiration, Groundwater level, Phreatophytes, Consumptive use, Water permits, Water quality standards, Quality control, Water quality management, Effluent standards, Low flow, Computer models, River basin management, Public policy, Water supply development.

This report covers the 21st year of managed water research conducted by the Colorado Water Resources Research Institute. It describes progress in research and technology development in the following high-priority water problems facing Colorado: impact of the Endangered Species Act in the South Platte Basin; low-flow criteria for effluent discharge permits; Crane habitat maintenance – South Platte River; geochemistry of bedrock aquifer recharge in the Denver Basin; guidelines for developing basin-of-origin compensation; basinwide water system computer simulation; voluntary integrated basinwide water management; evapotranspiration of natural vegetation in the Closed Basin; groundwater recharge; optimum reservoir siting and sizing; drought analysis; floodplain management; urban water conservation; Ogallala water conservation; water quality monitoring; land treatment and disposal of sewage effluent. The report also describes the Institute's technology transfer activities and illustrates their significance to the practical concerns of water users and managers in Colorado. The Institute program also provides training for future water resource professionals through experience on research projects. (Evans-CO St. U.)
W88-00551

INSTITUTE FOR RESEARCH ON LAND AND WATER RESOURCES, ANNUAL REPORT 1984,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
D. L. Fisher.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197380/AS. Price codes: A03 in paper copy, A01 in microfiche. Publication No. LW8504, 1985. U. Ed. 85-1077. 52 p. Project No. USGS G929.

Descriptors: *Pennsylvania, *Institute for Research on Land and Water Resources, *Technology transfer, *Water Resources Institutes, Interdisciplinary studies, Environmental effects, Natural resources, Conservation, Waste management, Water management, Acid rain, Land use, Remote sensing, Model testing, Feasibility studies, Hazardous materials, Fate of pollutants, Nutrient removal, Monitoring, Assessments, Regional planning, Publications, Professional personnel.

The interdisciplinary research programs and technology transfer activities of the Institute for Research on Land and Water Resources are discussed. Primary research areas in 1984 were: water resources management; environmental impact assessment; acid precipitation; remote sensing; residuals management; and planning and development. As examples, specific projects focused on the development and application of models for hydrologic processes; hazardous and toxic waste management; educating the public about low-level radioactive waste and its disposal; agricultural pollution; the impacts of variations in river or stream flow on fish populations; and the effect on a stream of nutrient removal. Technology transfer efforts concentrated on the problems of atmospheric deposition and water conservation. Efforts also included development of a sourcebook of water quality data for use by Delaware River management personnel and a training manual to be used in evaluating erosion and sedimentation control plans. Also, the Institute's graduate training program and advisory committee are discussed. A directory giving areas of expertise of Institute faculty and staff is included as is a listing of recent publications. (Fisher-Penn St. U.)
W88-00553

FISCAL YEAR 1984 PROGRAM REPORT (NORTH CAROLINA WATER RESOURCES RESEARCH INSTITUTE),
North Carolina Water Resources Research Inst., Raleigh.
D. H. Moreau.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-197372/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report No. G-924-01, September 1985. 34 p, 2 fig. Project No. USGS G-924-01. Contract No. 14-08-0001-G924.

Descriptors: *Research, *Information transfer, *Training, *North Carolina, Aquatic weed control, Hydrilla, Eutrophication, Algal control, Phytoplankton, Eutrophic lakes, Limiting nutrients, Nutrient Requirements, Agricultural runoff, Agricultural drainage, Wetlands, Wetland filters, Septic tanks, Soil moisture retention, Watershed protection, Land use.

The Institute, in cooperation with the U.S. Department of Interior Geological Survey, supported research, graduate training, and information transfer programs in response to major water problems of concern to the state and federal water agencies. The report describes the interaction between the Institute and the state and federal water agencies in setting research priorities. The Institute has a 34-member Advisory Committee to assist in these cooperative functions. Six research projects were supported with U.S. Department of the Interior Geological Survey funds. Progress reports are included for four continuing projects: (1) Arresting Eutrophication in Rivers, (2) Environmental Control of Phytoplankton in a Piedmont Reservoir, (3) Pollutant Removal Effectiveness and the Hydraulics of Wetland Filter Areas for Pumped Agricultural Drainage Water, and (4) Movement of Soil Moisture and Chemical Pollutants from Wastewater Disposal Systems Through the Soils and Saprolites in Piedmont Landscapes. Final completion reports and synopses are provided for two projects: (1) Refinement of Chemical Control Procedures for Hydrilla and Alligatorweed in Piedmont and Coastal Plains Waters and (2) The Practicality of Preserving Water Supply Reservoir sites in North Carolina: An Initial Assessment. A program of information transfer supported primarily from state funds is described. These efforts include workshops, research review meetings, seminars, newsletters, and an extensive public service role by both the Institute Director and Associate Director. (Lambert-UNCWRRI)
W88-00554

FISCAL YEAR 1986 PROGRAM REPORT. (NORTH CAROLINA WATER RESOURCES RESEARCH INSTITUTE).
North Carolina Water Resources Research Inst., Raleigh.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 217402/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1243-01, May 1987. 27 p. Grant No. 14-08-0001-G1243.

Descriptors: *Research, *Information transfer, *Training, *North Carolina, *Water Research Institute, Water quality, Fisheries, Radon, Wetlands, Groundwater movement, Groundwater recharge, Groundwater pollution, Estuarine fish.

This report summarizes the North Carolina Water Resources Research Institute FY 1986 research program funded by the U.S. Department of the Interior, Geological Survey (Allotment grant and by state and other federal and non-federal funds). The research program focused on the following areas considered critical to the North Carolina water resources program: Groundwater Movement and the Transport of Contaminants in the Saturated or Unsaturated Zone; Protection of Surface Waters from Toxics and Excessive Nutrients; Protection and Management of Drinking Water Supply Watersheds; Financial Aspects of Urban Water Management; Coastal Water Management; and Aquatic Weed Management. Federal funds were used to support work on four research projects. One continuing project addressed the issue of water quality and the health of estuarine fishes. A second project which investigated water problems associated with groundwater recharge in the Piedmont was completed. Another completed research project provided information essential to predicting the occurrence of radon in North Carolina groundwater. A fourth study examined the use of wetland areas to improve water quality. Additional studies and an information transfer program were supported using state and local government funding. A progress report and/or a completion report for those projects receiving U.S. Department of the Interior, Geological Survey, support is included in this Annual Report. (Lambert-UNC, WRRI)
W88-00942

FISCAL YEAR 1986 PROGRAM REPORT (GEORGIA ENVIRONMENTAL CENTER),
Georgia Inst. of Tech., Atlanta, GA. Water Resources Research Inst.
B. Kahn.
Available from the National Technical Information Service Springfield, VA 22161, as PB87-217394/AS. Price codes: A04 in paper copy, A01 in microfiche. Program Report G1219(01), May 1987. 44 p, 6 tab. Contract No. 14-08-0001-G1219. Project No. USGS G1219-01.

Descriptors: *Research, *Information transfer, *Training, *Georgia, Groundwater movement, Finite element analysis, Infiltration, Surface-groundwater relationships, Runoff, Network design, Water pollution, Electro-chemistry, Chemical analysis, Chromatography, Subsurface drainage, Irrigation systems.

The following six research projects were completed: (1) Modeling Transient Ground Water Flow in Multilayered Aquifier Systems, by M.M. Aral. A recently developed steady-state model for multilayer aquifers was extended to consider unsteady conditions such as major water withdrawals at wells, and was tested in numerical experiments. (2) Microcomputer Program for Estimating Drought Stream Flow Reduction Due to Wells, by J.F. Dowd and K.J. Hatcher. A model was developed for computing flow from streams into adjacent aquifers, subjected to sensitivity analysis for the range of input rates expected in south Georgia, and used to indicate the most influential parameters under these conditions. (3) Effect of Soil Dispersion on Surface Runoff in Southern Piedmont Soils, by D.F. Radcliffe and W.P. Miller. Greenhouse experiments with a rain simulator and three types of soils showed that infiltration rates decreased with time due to clogging of pore space by clay particles dislodged by rain drops, leading to increases in surface runoff. (4) Optimal Schemes for Groundwater Quality Monitoring in the Shallow Aquifer, Dougherty Plain, Southwestern Georgia, by S. Rouhani. Advanced geostatistical techniques have been used to select primary target zones for locating sampling wells based on available leakance data. (5) The Analysis of Azo Dyes in Water by High-Performance Liquid Chromatography with a Swept-Potential Electrochemical Detector, by P.E. Sturrock. Initial efforts to combine chromatography with electrochemical analysis of the chromatographic fractions showed that some unseparated dyes could be distinguished readily at low levels in industrial effluent. (6) Evaluation of Subsurface and Outflow Water Quality from a Drainage - Subirrigation System in the Georgia Flatwoods, by D.L. Thomas, A. Shirmohammadi and R. Lowance. Data from an experimental site are given for pH, nitrogen, phosphorus, and chlorine. Nitrate and chloride levels were higher than at plots that were not maintained with drainage subirrigation systems. (Kahn - GA Inst. Tech.)
W88-00962

10. SCIENTIFIC AND TECHNICAL INFORMATION

10A. Acquisition And Processing

GUIDE TO WATER RECORDS OF NEW MEXICO, 1897-1983,
New Mexico State Univ., Las Cruces. Dept. of History.
D. A. Miller, J. T. Lee, and I. G. Clark.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-205316/AS. Price codes: A07 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces. Technical Completion Report No. 208, July 1986. 124 p. State Project No. 1345637.

Descriptors: *New Mexico, *Irrigation districts, *Information transfer, *Archival collections, Water law, Water use, Management, Flood control, Data collections, History.

A Guide to Water Records of New Mexico, 1897-1983 is a compilation of various types of archival collections, representing a hundred years of water development in New Mexico. The collections include personal papers of individuals and organizations that dealt with the use and study of water in New Mexico. Many areas of the state are represented, including the Isleta Pueblo, Albuquerque, Las Cruces and the Carlsbad region. Thus the water archives represents a broad range of New Mexico's water history. The collections, now centrally housed at New Mexico State University Archives, are available for researchers. The collections were organized and arranged according to archival standards. To aid researchers in locating documents, a finding aid is available for each collection. Together these records form a core to base future additions of water records and papers. Therefore, continuing and expanding the availability of information to researchers. Also, these records complement WRRI Report 190, 'A Guide to Elephant Butte Irrigation District Records'. (Miller-NM St U.)
W88-00721

STATE AGENCY LIBRARIES OF TEXAS UNION LIST OF SERIALS: SUPPORT ACTIVITIES REPORT.
Texas Natural Resources Information System, Austin.
October 1977. 25 p, 9 fig, append.

Descriptors: *Libraries, *Information exchange, *Information systems, *Computers, *Data storage and retrieval, Information retrieval, Data transmission, Data collections, Automation, Computer programs, Data acquisition.

The State Agency Libraries of Texas (SALT), with the help of the Texas Natural Resources Information System (TNRIS), has developed a computerized list of all serials (or periodicals) and their location among the member libraries. TNRIS development support of the SALT Union List of Serials included the services of a computer analyst, a programmer to design and implement the system, keypunch services to convert periodical data to machine readable form, and computer time to develop and test the system. The SALT Union List of Serials should improve bibliographic and physical access to periodical materials located in state agencies and provide more efficient delivery of periodical articles. It should also provide more effective use of individual library funds in the provision of periodical material, and offer increased awareness on the part of state personnel of the library resources and services available in state government agencies. Updates to the SALT List will continue to be provided by SALT member libraries through the Texas State Library consultant to Texas State Agencies. Verified updates will continue to be keypunched and processed by TNRIS Systems Central. TNRIS System Central staff are currently conducting an inventory of nonmachine processable data housed in the thirteen participating TNRIS agencies. The availability of the inventory results and the SALT periodical list will provide greatly expanded services to the TNRIS user community. (Geiger-PTT)
W88-00803

10B. Reference and Retrieval

DISTRIBUTION REGISTER OF ORGANIC POLLUTANTS IN WATER-WATERDROP,
Midwest Research Inst., Kansas City, MO.
For primary bibliographic entry see Field 10C.
W88-00408

COMPUTER SURVEY OF GAS CHROMATOGRAPHY/MASS SPECTROMETRY DATA ACQUIRED IN THE U.S. ENVIRONMENTAL PROTECTION AGENCY SCREENING ANALYSIS: SYSTEM AND RESULTS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5A.
W88-00409

SAS BASED HYDROLOGIC INFORMATION STORAGE AND RETRIEVAL SYSTEM, PART I,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W88-00725

STATE AGENCY LIBRARIES OF TEXAS UNION LIST OF SERIALS: SUPPORT ACTIVITIES REPORT.
Texas Natural Resources Information System, Austin.
For primary bibliographic entry see Field 10A.
W88-00803

10C. Secondary Publication And Distribution

DISTRIBUTION REGISTER OF ORGANIC POLLUTANTS IN WATER-WATERDROP,
Midwest Research Inst., Kansas City, MO.
B. L. Carson, J. E. Going, V. Lopez-Avila, J. L. McCann, and C. J. Cole.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 2, Ann Arbor Science, Ann Arbor, MI. Edited by Lawrence H. Keith. p 497-525, 11 fig, 16 tab, 4 ref.

Descriptors: *Data acquisition, *Organic compounds, *Network design, *Data processing, *Data storage and retrieval, Data collections, Computers, Industrial wastes, Drinking water, Automation, Networks.

The U.S. Environmental Protection Agency compiled a comprehensive list of organic pollutants found in water called the Shackelford-Keith List. When the list was published in December 1976, plans were being made to fund a database called WaterDROP that would include all the many fields of information not available in the Shackelford-Keith List. The initial data sheet developed for WaterDROP defined the major types of input data and served as the initial base for definition. The second data sheet was designed to handle literature with multiple compounds, sample locations, and water type with minimum data entry. The third data sheet was developed in close conjunction with the contractor. Currently, the WaterDROP data entered from 213 documents include 26,800 occurrences of about 1000 organic compounds in drinking water, natural water bodies, industrial and sewage effluents, aqueous process streams, and associated suspended particulates and sediments. The online database contains 10,600 citations for 869 unique compounds. (See also W88-00406) (Geiger-PTT)
W88-00408

PROCEEDINGS, MISSISSIPPI WATER RESOURCES CONFERENCE, 1985.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 6B.
W88-00544

POLLUTION FROM ALASKAN OIL AND GAS OPERATIONS: CITATIONS FROM THE OCEANIC ABSTRACTS DATA BASE (1974-NOV 82).
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-852822. Price codes: N01 in paper copy, N01 in microfiche. November 1982. 57 p.

Descriptors: *Oil pollution, *Oil spills, *Oil recovery, *Water pollution effects, Oil wastes, Oil industry, Oil refineries, Cleanup operations, Oil skimmers, Oil slicks, Water pollution, Water pollution control, Legal aspects.

Sixty-six citations, with abstracts, pertain to mechanisms and effects of environmental pollution associated with oil and natural gas operations in Alaska. Effects at specific locations and specific species are considered. Legal aspects of oil pollution from a variety of sources are discussed. Specific topics covered include: technology for oil recovery, landfill disposal of spilled oil, analytical procedures, impact of oil pollution on aquatic organisms, modeling of oil spills, liability related to oil spills, and the fate of spilled oil in aquatic environments. (Halterman-PTT)
W88-00911

ACID PRECIPITATION: EFFECTS ON THE AQUATIC ECOSYSTEM; CITATIONS FROM THE U.S. DEPARTMENT OF ENERGY (EDB) DATA BASE (1977-SEPT 83).
National Technical Information Service, Springfield, VA.
Available from the National Technical Information

Service, Springfield, VA 22161, as PB83-872242. Price codes: N01 in paper copy, N01 in microfiche. September 1983. 210 p.

Descriptors: *Abstracts, *Acid rain, *Air pollution effects, Acidification, Aquatic environment, Ecosystems, Aquatic life, Environment, Aquatic animals, Aquatic plants.

A bibliography is presented which contains 242 citations pertaining to the effect of atmospheric acid deposition on lakes and streams, and on the associated plants and animals. Included in this bibliography are exposure pathways, natural or artificial buffering, and the effects on productivity within aquatic ecosystems. Each citation includes an accession number, title, author, abstract, and keyword. This bibliography contains 90 citations which are new entries to the previous edition. (Halterman-PTT)
W88-00912

ACID PRECIPITATION: EFFECTS ON TERRESTIAL ECOSYSTEMS (OCT 83 - SEPT 84); CITATIONS FROM THE U.S. DEPARTMENT OF ENERGY (EDB) DATA BASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-876036. Price codes: N01 in paper copy, N01 in microfiche. October 1984. 181 p.

Descriptors: *Abstracts, *Acid rain, *Air pollution, Ecosystems, Air pollution effects, Environmental effects, Hydrogen ion concentration, Sulfur, Forests.

Two hundred and twelve citations, with abstracts, from the United States Department of Energy Data Base, represent material published from October 1983 to September 1984 concerning the effect of acid rain on terrestrial ecosystems. Included are effects on soils, forests, and other vegetation. Trends in geographical distribution of acid rain deposition are also covered. Specific topics include annual variations in chemical composition of atmospheric precipitation, methodology of acid rain research, and effects of acid rain in various parts of the world (including Germany, Norway and many areas of the United States). Citations are indexed according to subject terms. (Halterman-PTT)
W88-00913

10D. Specialized Information Center Services

DISTRIBUTION REGISTER OF ORGANIC POLLUTANTS IN WATER-WATERDROP,
Midwest Research Inst., Kansas City, MO.
For primary bibliographic entry see Field 10C.
W88-00408

TEXAS NATURAL RESOURCES INFORMATION SYSTEM FILE DESCRIPTION REPORT.
Texas Natural Resources Information System, Austin.
TNRIS-002, (1982). 343 p, + microfiche.

Descriptors: *Networks, *Texas, *Data collections, *Data storage and retrieval, *Information systems, *Natural resources, *Texas Natural Resources Information System, Water resources development, Network design, Hydrologic data collections, Data acquisition, Information retrieval.

In June 1972, the Texas Interagency Council on Natural Resources and the Environment approved a recommendation from its Water Oriented Data Program Section to establish the Texas Natural Resources Information System (TNRIS). The TNRIS identifies textual, computer processable, mapped and other data and categorizes it into six groups: base data, biological, meteorological, geologic and land, water, and socio-economic. The water category contains data on: sediment load, statewide monitoring networks, water quality, estuaries, reservoirs, streams, heavy metals in estuaries, flood flow frequency, submerged lands-sediment, water levels, subsurface injection wells, well drillers' logs, well samples and cores, water use, irrigation, municipal and industrial return flows, interim return flow system, effluent reports, water rights permits, water districts, certified water or wastewater operators, dams, sewage treatment plants, municipal solid waste facilities, flood hazard analyses, waste treatment planning, industrial solid waste registration, permit applications, and in situ uranium mining groundwater monitoring. Data are provided from TNRIS to state, federal, local and private entities in the form of printed reports, punched cards, computer tape, aerial photography, microform, and computer graphics output. (Geiger-PTT)
W88-00674

TEXAS NATURAL RESOURCES INFORMATION SYSTEM, WATER ORIENTED DATA BANK: SYSTEM CAPABILITIES.
Texas Natural Resources Information System, Austin.
June 1973. 29 p, 12 ref, append.

Descriptors: *Data processing, *Data storage and retrieval, *Data transmission, *Texas, *Computers, Data collections, Automation, Hydrologic data collections, Resources development, Natural resources, Computer programs, Water resources.

The Texas Water Oriented Data Bank (TWODB) is an important subsystem of the Texas Natural Resources Information System (TNRIS). The TWODB is a user-oriented data bank which, in addition to basic storage and retrieval facilities, provides computer-printed reports, graphic output, interface with remote terminals, statistical packages, and microfilm reproduction. To facilitate storage and retrieval of data in the TWODB, six categories of general data and information were defined: base data, meteorological resources, biological resources, water resources, geologic and land resources, and socioeconomic resources. The steps a user might take to obtain information from the TWODB, and related TNRIS publications and data retrieval alternatives are listed. The primary goal of Phase III of the TWODB is to complete the basic implementation of the interagency TWODB and demonstrate the applicability of its basic concepts. Upon completion of Phase III, a comprehensive set of interagency data files (both hard and soft) should be available for easy access throughout the State. An appendix to this report gives examples of printed TWODB output. (Geiger-PTT)
W88-00796

10F. Preparation Of Reviews

SECOND INTERNATIONAL CONFERENCE ON GROUND WATER QUALITY RESEARCH, PROCEEDINGS.
Oklahoma State Univ., Stillwater. Univ. Center for Water Research.
For primary bibliographic entry see Field 5B.
W88-00534

CATALOGUE OF RECENTLY DESCRIBED DIATOM TAXA FROM AFRICA AND NEIGHBOURING ISLANDS (1965-1980),
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 2H.
W88-00833

B.J. CHOLNOKY DIATOM SLIDE COLLECTION,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 2H.
W88-00834

POTENTIAL FOR BIOMAGNIFICATION OF CONTAMINANTS WITHIN MARINE AND FRESHWATER FOOD WEBS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W88-00839

ENVIRONMENTAL FEATURES FOR FLOOD-CONTROL CHANNELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W88-00845

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1983 Annual Report to the President and Congress: National Acid Precipitation Assessment Program.
W88-00786 5B

Acid Precipitation: Effects on the Aquatic Ecosystem; Citations from the U.S. Department of Energy (EDB) Data Base (1977-Sept 83).
W88-00912 10C

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